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## New Automatic Cut-Off Engine.

The engine we illustrate herewith is built by the Erie City Iron Works, Erie, Pa. It is from entirely new designs and patterns.

The bed plate, it will be noticed, is a modification of the Porter type, the centers being kept as low as practicable, to avoid vibration at high speeds. A receptacle for drip is cast with the bed, which, extending around, serves as well to tie the sides of the bed ogether.

The horizontal section will give an idea of the construction of the cylinder steam chest and valve. The piston valve is packed by means of a thin ring of the proper width, this ring being the valve proper. This is a spring ring, and has a small hole drilled in the port side, which permits live steam to enter underneath it when steam is being admitted to the cylinder. This is to counteract the tendency of the ring to close up. The valve admits steam by the inner edges, so that the valve stem stuffing-box is exposed only to steam or exhaust pressure. The annular ports around the rings and the centrally located steam chest provide for accurately balancing the valve in a way common to piston valves. The proportion of valve and seats is such that the rings travel over the seat at short cut-off, thus preventing the formation of shoulders.

The crank-shaft pin is turned from the solid forging, and has a diameter equal to that of the shaft, and the combined length of the main journals is about five times the diameter of the shaft. The cast counterbalances are made fast to the crank, and are of sufficient diameter to permit accurate counterbalancing.

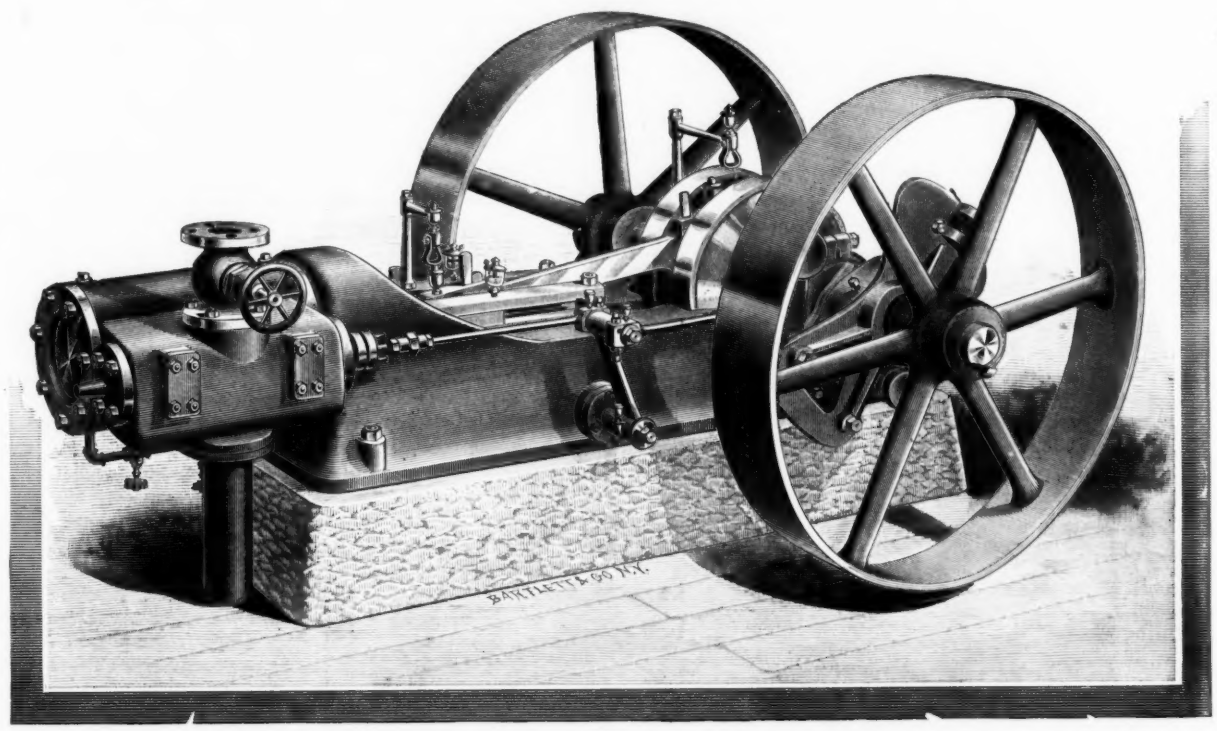
The slides are of the locomotive type, the bottom slides being independent of the bed, to permit adjustment. The top slide is heavy enough to permit running under should it be found necessary to do so, but this is not advised. The piston packing consists of three sprung rings. The steel piston rod is fastened in the crosshead eye by means of a key.

The governor (see page 2) is of the shaft or "isochronal" type, but has points in its construction peculiar to itself. The main frame of the governor has a guide cast on the hub next to the eccentric, to receive the corresponding slide which is cast on the latter. This slide is extended at the top, and forms an arm to receive the links connecting the bell crank levers to the eccentric. The latter has a slotted hole, through which the shaft passes and permits the eccentric to be moved across the shaft in a straight line, altering the travel of the valve to correspond with the work required of the engine without changing the lead. The slide on the eccentric is also extended on the lower side, and forms a guide which passes through a movable plate on the governor frame, which has an extension to receive the guide. This forms a secondary guide for directing the travel of the eccentric across the shaft. A compression spring is placed around this guide, and has for its lower seat the projection on the movable plate through which the guide passes. Its upper seat is fixed, and is formed by a shoulder on the guide on the eccentric.

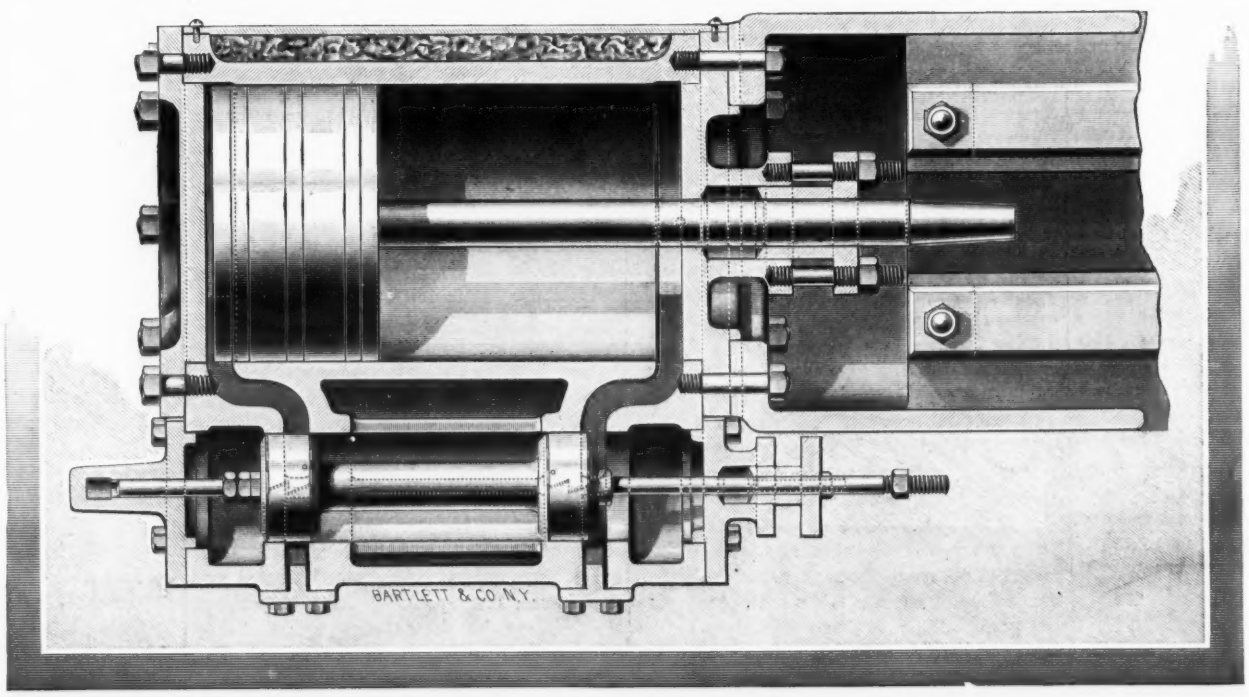
The bell crank lever weights are fulcrumed on the governor frame at two projections on the upper side, through which pass steel pins forming the fulcrums. One end of each bell crank is connected by steel pins to the link attached to the upper end of the eccentric, the other end of each bell crank forms the centrifugal weight.

It will be noticed that the arms of the bell cranks are considerably out of the perpendicular; this gives the weights a certain amount of gravity, which is proportional to the gravity exerted by the eccentric, when in the vertical position, as shown, and exactly balances the eccentric and parts. This effect is also entirely independent of the centrifugal force exerted by the weights.

The operation of the governor will be readily understood by those acquainted with such mechanism.




NEW AUTOMATIC CUT-OFF ENGINE.




HORIZONTAL SECTION OF CYLINDER.

## Symbolizing Patterns.

BY P. S. DINGEY.

Two firms seldom adopt the same method of marking and recording their patterns, while a large stock is often accumulated regardless of any system. In some places a man is employed especially to look after the patterns, who disregards anything like system, and says he "knows where to find any pattern." At the same time they may be piled together like a lot of kindling wood. What this rule of thumb individual says about "knowing where to find any pattern" may be true, but should some unforeseen circumstances remove him, who is to find the patterns then? I suppose somebody will; but what a disadvantage such a firm labors under through not adopting a system of recording and symbolizing their patterns.

For those who have no system I would recommend the following: A letter and a number are fixed on the pattern so as to come out in the casting. The letter is used to designate the class of machinery, or it may be a certain machine, while the number distinguishes one part from another. In most cases the mark a pattern is to have is handed to the foreman pattern maker from the drawing room where the record is kept. The number of each piece should be marked on the drawing; this is not generally done, but I think it should be, as it would facilitate the work in the shops.

The method which I have been working for some time is shown herewith. The column "pattern at" will be found very useful for those sending out their patterns, to show where they are, but before using this column it will be necessary to give each firm with which business is done, a number, and make an index

accordingly. When a pattern is sent out, the number corresponding to the firm it is sent to, is marked with lead pencil in the column "pattern at," and when returned is rubbed out, showing the pattern is at home.

It often happens that in a set of patterns for a certain machine there are those that will do for other machines; in such cases enter the same letter and number in the record of patterns with other machines.

There is always a lot of miscellaneous patterns that cannot be so well classified, yet they are often in use and need to be marked. These may be given a symbol and entered under the heading "miscellaneous." There are also many rough patterns made, the kind that is generally "wanted to be cast to-day." All moulders are acquainted with this kind; there is no use in recording such, as they are seldom used a second time.

With large firms carrying patterns of a number of different machines and many classes of machinery, the question may arise what to do when the alphabet is exhausted. In some cases a cipher is put at the beginning of each number. I adopted this plan for one machine, but would not do so again, because there is not enough difference in the mark to distinguish at a glance one class from another. Thus the marks A. 10. and A. 010. look like very near relations, which must be avoided in classifying. I think a better way, after going through the alphabet once, is to use two letters commencing with A.B.—A.C.—A.D. until through the alphabet again, and then begin with BC. BD. BE. and so on, thus making it possible to have a large number of distinct and separate classes.

The advantage of recording and marking patterns is that it greatly facilitates ordering the castings and helps to prevent confusion in the foundry. When the order for castings is written out (as it always should be) for the foundry, the mark corresponding to that on pattern is put on the order, so that the moulder and pattern maker cannot misunderstand each other by naming things differently. Again when a pattern has a particular mark, every loose piece (and sometimes there are a great many) belonging to the pattern and core boxes can be stamped like the pattern mark; the benefit of this is apparent. There is often much trouble caused by not knowing where a certain loose piece belongs, and castings are often made minus a piece, just because the moulder didn't know that it belonged to the pattern.

It is also a great help towards checking the casting when received. Especially is the marking of patterns necessary for this, as gentlemen of the quill profession who receive the goods are not usually acquainted with the names of the parts of machinery.

The finding of patterns when needed may be rendered easy even to a stranger if the shelves where patterns are stored are marked with the letter corresponding to the class.

I might go on enumerating the advantages gained by having a system such as I have described. There may be better ones, but the above has been practiced successfully. Every firm, large or small, should have some system, and though it may be a defective one, it is better than none.

SAMPLE ENTRY FOR PATTERNS.

CAST-IRON.

| Pattern mark. | Name of Part. | Weight Pounds. | Casts Wanted. | Pattern at | Remarks. |
|---|---|---|---|---|---|
| A. 1 | Bed Plate..... | 8075 | 1 | 1 | |
| A. 2 | Side Frame..... | 672 | 4 | 1 | |
| A. 3 | Steam Cylinder.. | 1100 | 1 | 1 | |
| A. 4 | Pump " .. | 800 | 2 | 2 | |
| A. 5 | Driving Disk.... | 100 | 2 | 2 | Make 2 R. Hand and 2 L. H. to make opposite hand, change to drawing. |

*Scribner's Monthly*, for April, contains an illustrated article on "The Typewriter." Of the hundred or so men represented in the factory, only one luckless fellow appears to be at work. If the representation is correct, making typewriters must be a comfortable business to work at.

## English Boiler Inspection.

By W. H. Booth.

EIGHTH PAPER.

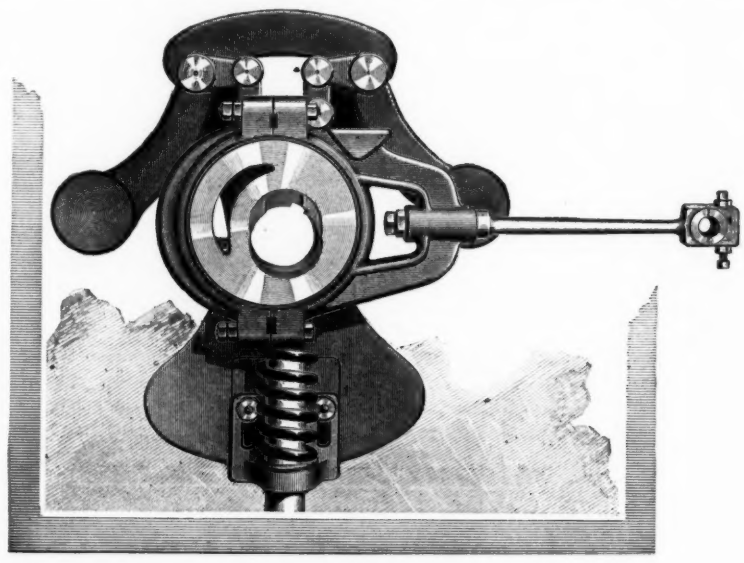
Since the appearance of the recent article on mid-feather seatings, a singular confirmation or example of the disastrous results of the mid-feather seating has been related to me by a Brooklyn engineer once in charge of several boilers set in this faulty manner. On one occasion, the usual cleaning time, a seam of rivets was found started, and further examination revealed the fact that a smart blow with a light hammer perforated every one of the five rings of plate along the line of the seating, and proved the plates to be corroded down to a thickness of brown paper. Each of several boilers thus examined was similarly affected, and had to be rebottomed and reset on side seatings. Though the internally fired boiler is little used in America, it is well to draw attention to this point, as showing the nature of such and similar arrangements, and how to guard against their dangers.

Though the externally fired boiler is chiefly used in America, and is here allowed a greater working pressure than would be allowed in England to an internally fired flue boiler set in England, external firing is not considered so safe as the other method, the deterioration of the shell plates under the action of the fire being considered sufficient to warrant a reduction in the working pressure below what would be allowed to a shell not exposed to the direct action of fire, and though there are boilers of 84 inches diameter fired externally, as with the revolving grate, their number grows less, and external firing is chiefly limited to shells of 48 or 54 inches—plain, cylindrical, egg-ended boilers, such as are commonly used at collieries, and without tubes of any sort. The facility of employing large grates under such boilers, whereon dross or waste, unreliable coal can be burnt, is the chief factor in continuing the use of such boilers, which also are so much cheaper to construct than boilers of the Lancashire or Cornish type.

In addition to what has been said of the side wall system of seating, it may be well here to call attention to the direction of the draft. When first the split draft was employed the course of it was usually as follows: From the fires in the tubes the smoke or gases passed of course to the back end of the boiler, where the current was taken off to each side and passed along the two side flues to the front end of the boiler, remaining there beneath the boiler and passing right under the boiler in the bottom flue and away to the chimney.

It was a frequent occurrence that some one of the ring seams of the boilers, when thus set, would be found to give way for two or three feet circumferentially equally on each side of the center line. Investigation showed that these seam rips were due to the unequal expansion of the upper and lower portions of the shell. The great mass of water in the boiler bottom being cold, or not above 100° of temperature, whilst the upper portion of the boiler contained steam at 30 pounds pressure. This want of circulation was the cause of seam rips, and brought about a fresh arrangement of draft, and instead of, as formerly, the hot gases passing from the furnace tubes to the side flues, it is now the universal practice to turn the draft from the tubes along the bottom flue, and finally along the two side flues to the chimney. By this arrangement the lower part of the boiler becomes heated very much more readily and quickly, and the frequent seam rips have been almost abolished.

The danger of a seam rip is not very great, for the boiler is held together by the internal furnace tubes; but when these are absent, as in the case of plain cylindrical boilers as above named, it is a wise precaution to insert a good, stout longitudinal bar stay, so as to prevent a rip causing serious explosion. One of the worst rips which came under my notice was in a Lancashire boiler which had been suddenly emptied for some disarrangement of the feed check valve. This was set right in a few minutes only, and the cold feed turned on to fill up the boiler for work. Cooling off the lower part of the shell thus suddenly caused a circumferential rent about five feet in length, which resulted in the renewal of the boiler, already of considerable age. Further on the subject of seatings may be added the warning to use no lime mortar anywhere in contact, or where by any chance it might come into contact with the plates. Though not dangerous when dry, the presence of slight moisture causes a very energetic chemical action between the iron and the lime, resulting in rapid corrosion of the former. It appears as though the lime served as a carrier of oxygen to the iron, and the result is a bright red oxide.



Governor.—See Page 1.

## Shop Notes.

The new building of the Brown & Sharpe Mfg. Co. is nearly completed and ready for occupancy. It is 195×47 feet, four stories high, and fireproof, the stairways being of iron, and the floors supported upon iron beams, with brick arches between, being in this respect, as well as in the points of light, ventilation, sanitary appliances, etc., fully equal to the other buildings which we have already described.

It is with them no longer a theory, merely, that it pays to give to workmen the best possible surroundings, and to have their shops clean, neat, orderly, well lighted, heated and ventilated; but speaking from experience they can say that these things pay; that they have a good influence upon their product; that men who are surrounded by an air of order, neatness and cleanliness, and have plenty of air and light, will produce more and better work than they would under less favorable circumstances—a fact which no one acquainted with human nature will be disposed to dispute, though it is far too common to disregard it in the construction and management of shops.

Perhaps no more convincing proof of the correctness of this principle could be found than the fact that, after some years of trial, the B. & S. Co. have in their new building kept fully up to the standard of excellence shown in the others.

The shafting and power have not yet been put in, but will be soon, after which it is intended to relieve some of the departments which have become too much crowded by the natural growth of business, and the addition of new lines of manufacture.

At one side of the new building is a wing 41×51 feet, the lower floor of which is used as a stable, which, in its appointments, compares very favorably with the best of fire department stables.

It is intended to divide one of the upper stories of this wing into three rooms, for the use of the employes during the evenings, or for those who for any reason are not working.

The first of these rooms will be for social uses, and will be comfortably fitted up and furnished, and warmed by an open fireplace. One of the others will be for those who wish to retire from the general room for private conversation, and the remaining room will be fitted up as a reading room, and supplied with the leading periodicals and newspapers.

In the shop there is evidence of constant improvement in methods. A constantly increasing number of grinding and milling machines are used, and a very large proportion of the cylindrical and flat work is finished and brought to size by grinding.

In the room which is devoted to grinding, there are twelve of their well-known universal grinding machines at work, grinding not merely hardened work and tools, but ordinary fits and journals on spindles, shafts, traverse screws, etc., without regard to whether they are hardened or not. No mechanic who watches these machines at work, and examines the work turned out by them, can have much doubt of the superiority, in every respect, of this method over filing to gauge in the usual manner.

Besides these regular universal grinders there are a number of special grinding machines which have been built for certain specific jobs, which are very ingenious and effective. Among others, there is one for grinding out the holes and facing off the sides of their patent gear cutters. To the spindle of this machine are fitted a number of chucks of different sizes, which hold the cutters, gripping them by the outer edge of the teeth, and at the same time drawing them back against a hardened steel ring, ground true, which comes in contact with the cutter at the pitch line only, and thus trues it sideways at the vital point. The cutter is secured by simply turning a milled ring on the chuck.

The machine being started up, the cutter is rapidly revolved, and by turning a hand wheel in front of the machine a small emery wheel, running at a very high speed, is fed through the hole to grind it out, while at the same time, and by the same movement, another wheel comes in from the back and faces off the side where it comes in contact with the arbor collars.

The spindle is mounted in a frame which swings on a center which is between the spindle and the operator, and when the machine is in operation this frame is swung down and held against a stop, which brings the spindle into its proper position, but when, during the process of grinding, it is desired to apply a gauge to the hole, it is only necessary to take hold of the frame and swing it upwards and towards the operator, which carries the cutter up out of the way of the emery wheels, and at the same time loosens the belt which drives the spindle so that it stops, enabling the gauge to be applied; then by letting it back onto the stop it is restored to its proper position, and at the same time the belt again comes in contact with the pulley, starting up the spindle.

Another application of the grinding principle is seen in the machine for finishing the rims of their standard gear wheels. The rims of these wheels are simply roughed out in the lathe, being left somewhat wider and larger in diameter than finished sizes, to allow for grinding. The teeth are then cut in automatic machines, after which they are brought to this grinding machine, mounted upon a special arbor, and revolved, while by a single movement of a hand wheel three emery wheels are

applied to the rim, one at each side, and the other to the periphery, all moving and doing their work simultaneously.

There are a number of surface grinders at work also, and a large proportion of the surfaces, on cast-iron, which are usually finished by files and emery cloth, are here ground on these machines, it being found decidedly advantageous to do so for economical reasons, as well as on account of the superior quality of the work produced.

The milling machine, in its various forms, is used quite extensively on regular machine work, a great many of the jobs formerly done on the planer being now milled. Among the representative jobs done in this way are the slides of the spiral bed of their universal milling machines, and the slides of the universal grinder. A good many of the smaller pieces about the machines are milled to size and dimensions entirely.

In the sewing machine department they are building some straw braid sewing machines for the Wilcox & Gibbs Co., which are very ingenious, the frame of this machine being the most complicated and intricate casting that we remember to have ever seen. In this department are some jappaning ovens which would be interesting to the many who have tried to make a success of steam-heated japanning ovens and have failed; they are heated by steam pipes at the sides and top, placed very close together, and are entirely satisfactory.

The engine capacity has been doubled, the original engine having been provided with a crank-shaft of such proportions as to allow of an additional engine being put onto the other end of it, which has now been done. It is a model engine room, and is fitted up with every possible convenience. The taking of indicator diagrams is a common occurrence, and involves very little trouble, the pipes for the indicator being always in place, and the "indicator rig," or reducing motion, being arranged in such a way that it can be attached to the crosshead at any time while running. Back of each engine there is suspended from the ceiling an iron rod, which can be attached to the back cylinder head, and when it is necessary to take the head off the engineer does it by himself, simply taking off the nuts, attaching the rod, and rolling it back out of the way by an overhead trolley, where it hangs suspended until put on again. The engineer says he does the job by himself more easily than he formerly did it with the assistance of three or four men.

The library which has been provided for the men has constantly grown in usefulness, as well as in the number and variety of the books contained in it. It is not confined, as many suppose, to mechanical books, but embraces works on history, science, biography, travel, fiction, and miscellaneous subjects in great variety. The number of new books added has made a new catalogue necessary, which is now being prepared.

## Modern Locomotive Construction.

BY J. G. A. MEYER.

SIXTY-FOURTH PAPER.

*Counterbalance continued.*

Frequently, in fact in the majority of locomotives, the counterbalance and the wheel center is cast in one piece, as shown in Fig. 392. To determine the dimensions of a counterbalance of this kind, we should follow the rules given in the last paper. That is to say, we should consider the solid counterbalance to be made up of a number of segments bolted between the spokes, as shown in Fig. 390, and then determine the thickness of the counterbalance by a method precisely similar to that given in the last paper.

The correctness of the result of the calculation depends upon the correct position of the common center of gravity $G$ (Fig. 390) of the segments, and this center, of course, depends upon the correct position of the center of gravity $C$ of each segment, therefore we conclude that when the centers of gravity $C_1$ $C_2$, etc., of the segments are placed in incorrect positions the results of our calculations will be erroneous.

If in these segments metal had not to be cut out of the sides $i$ $h$ and $f$ $g$ to fit the spokes, and also out of the end $f$ $i$ to fit the rim, we could find very accurately and easily the centers of gravity $C_1$ $C_2$ of segments of uniform thickness by the method shown in Fig. 378. But it is not such an easy matter to find the center of gravity of segments of irregular shapes, as shown in Fig. 390, or Fig. 389; in fact, to find correctly the center of gravity of one of these segments involves a great amount of labor.

Now, when a solid counterbalance, as shown in Fig. 392, is considered to be made up of segments, we cannot lose sight of the fact that the sides of the segments and their outer ends must be formed to fit the spokes, and consequently we have to do with segments of irregular shape. To reduce the labor of finding the common center of gravity of these segments, or, in other words, to reduce the labor of finding the center of gravity $G$ of the counterbalance shown in Fig. 392, we may generally adopt the following method: The results obtained by this method, although not absolutely correct, will be sufficiently accurate for practical purposes.

Instead of considering the counterbalance (Fig. 392) to be made up of segments, as we should do, we treat it as it appears, namely, as one solid weight. Now, assume that the dimensions of this weight are such as will give a sufficient amount of metal, and not more, to counterbalance all the weights applied to the center of crank-pin, then by inserting, so to speak, this counterbalance into the wheel center, we must cut portions out of several spokes, and also cut a part out of the rim; by so doing we leave unbalanced portions of other spokes and a part of the rim on the crank-pin side, all of which are precisely similar in amount and form to those cut out. It must be evident that by leaving portions of the wheel itself unbalanced we create new disturbing forces, which will be just as injurious as a similar amount of unbalanced weight applied to the crank-pin. Therefore the thickness of our present counterbalance must be increased, so that not only the weights applied to the crank-pin are counterbalanced, but also have sufficient weight to counterbalance those portions of the wheel which had to be cut out to make room for the counterbalance. In the following example it will be seen how this exact thickness can be determined.

Ex. 78. The distance from the center of axle to the center of crank-pin is 12 inches; the total weight applied to the crank, which must be counterbalanced, is 500 pounds; the depth of the counterbalance from $h$ to $g$ is to be 8 inches, and is to terminate in the centers $a$ $b$, $f$ $e$ of the spokes $A$ and $B$ (Fig. 392). It is required to find the thickness of the counterbalance; this thickness is indicated by $t$, in Fig. 393. This figure represents a cross-section of the counterbalance through the line marked $r$ $s$, in Fig. 392.

In the first place make a drawing of the wheel, as shown in Fig. 392, then cut a templet conforming to the outline $a$ $b$ $h$ $f$ $e$ $g$ of the counterbalance, and find its center of gravity $G$ in a manner as shown in Fig. 385. Mark off this center of gravity $G$ on the drawing, and measure its distance from the center $i$ of the axle. Assume that we find the distance between $G$ and the center $i$ to be equal to 16 inches, we will then have all the data necessary for determining the thickness by calculation. The moment of the force due to the weight applied to the crank-pin is equal to

$$500 \times 12 = 6{,}000.$$

The moment of the force due to the weight of the counterbalance must also be equal to 6,000; hence, by dividing 6,000 by the distance of the center of gravity $G$ from the center $i$ we have

$$\frac{6{,}000}{16} = 375 \text{ pounds},$$

which is the weight necessary to counterbalance the weight applied to the crank-pin. But this counterbalance cuts portions out of five spokes and also a portion out of the rim. Suppose now that by calculation we find the total amount thus cut out of the wheel center to be equal to 80 pounds. Adding this weight to 375 pounds previously found, we have

$$375 + 80 = 455 \text{ pounds}$$

for the total weight of the counterbalance.

We now find the thickness of the counterbalance in a manner precisely similar to that given in the last paper, thus: Dividing the total weight of 455 pounds by the weight of a cubic inch of cast-iron, we have

$$\frac{455}{.26} = 1{,}750 \text{ cubic inches}$$

required in the counterbalance.

And lastly, dividing the number of cubic inches by the area of the face $a$ $b$ $h$ $f$ $e$ $g$ of the counterbalance we have

$$\frac{1{,}750}{256} = 6.83 \text{ inches},$$

which is the thickness of the counterbalance.

The simplest way of finding the area of the surface $a$ $b$ $h$ $f$ $e$ $g$ of the counterbalance will be to describe an arc $m$ $n$ $o$ midway between the arcs $a$ $g$ $e$ and $b$ $h$ $f$ (not drawn through the center of gravity $G$) then find by measurement the length of the arc $m$ $n$ $o$, and multiply this length by the depth $a$ $b$; the product will be the number of square inches in the face of the counterbalance.

Now it must not be understood that we claim to obtain, by the foregoing method, an absolute correct thickness for the counterbalance; the thickness, thus found, although correct enough for practical purposes, is only approximate, for the following reason: In the first place, we should have considered the counterbalance to consist of a number of segments fitted around the spokes and part of the rim, and then found the common center of gravity of these segments. Instead of this, we found the center of gravity of the whole counterbalance without making the proper allowances for the amount of metal which must be cut out of the counterbalance for the spokes and rim.

Consequently the center of gravity $G$, as we have determined it, will be somewhat—a very small amount—too far away from the center $i$ of the axle. Secondly, simply adding the weight of those portions of the spokes and rim which are cut out for the purpose of making room for the counterbalance, to the weight required for counterbalancing the weights applied to the crank-pin, is not quite correct. The proper course to pursue would be to find the common center of gravity of the portions cut out of the wheel center, also the correct distance between this center of gravity and the center of axle, and then find such amount of weight which, when applied to the center of gravity $G$ of the counterbalance, will have the same effect as the weight of the portions of the spokes and rim, cut out of the wheel center, applied to their own center of gravity placed at the correct distance from the center $i$ of the axle, and then add this weight, so found, to the weight required for counterbalancing the weights applied to the crank-pin. But such a course requires a great amount of labor, and may, on account of its complicacy, and the errors which may creep into it, give no better results than those obtained by the simpler method.

In ten-wheeled, mogul and consolidation engines, the weight of the reciprocating parts which are to be counterbalanced is often equally distributed throughout the driving wheels, thereby making the counterbalances in all wheels, excepting the main wheel, equal in size. The counterbalance in the main wheel will, of course, be a little larger than the others, because it has to counterbalance a heavier crank-pin than those in the other wheels, and has also to counterbalance the weight of one-half of the connecting rod, which the counterbalances in the other wheels have not to do, as will be seen by referring to our last paper. In some instances this arrangement will require in the main wheel a counterbalance whose thickness is too great to pass through the available space, consequently the total weights of the revolving and reciprocating parts are assumed to be equally distributed throughout all the wheels and calculations of the counterbalance made accordingly, making the counterbalances in all the wheels (main wheel included) equal in size and weight.

Even with this arrangement, considerable difficulty is often experienced in the endeavor to obtain sufficient weight in the counterbalance for narrow-gauge locomotives having driving wheels of comparatively small diameter, say three feet in diameter. In fact, in many of these small wheels it is impossible to obtain sufficient weight with cast-iron, and therefore these counterbalances are frequently cast hollow and filled with lead, as will be shown in our next paper.

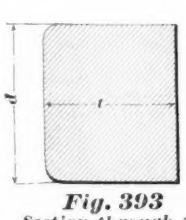



*Fig. 393*
*Section through r s.*

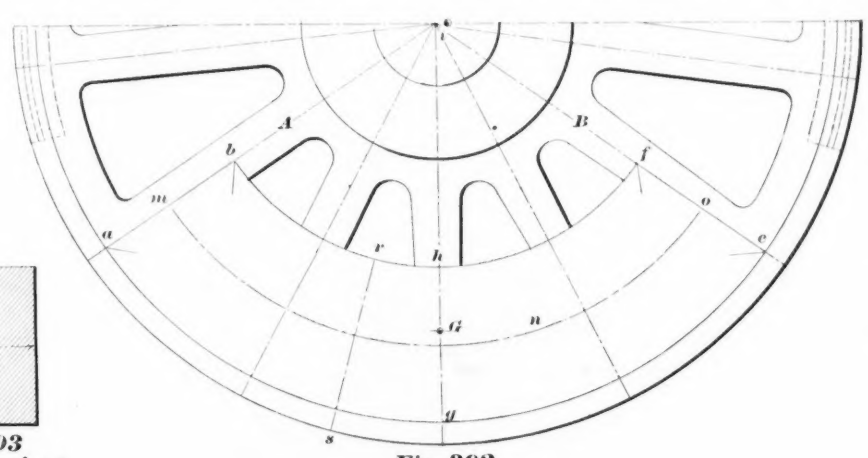



*Fig. 392*
LOCOMOTIVE CONSTRUCTION.

## Fire at the Delamater Iron Works.

On April 25th a fire at the Delamater Iron Works, West Thirteenth street, New York, destroyed the main machine shop, pattern shop and loam foundry. Three floors of the main machine shop contained considerable machinery for manufacturing specialties, and the upper floor was used as a pattern loft. This building appears to be a perfect wreck, and at the time of this writing it is impossible to state to what extent the heavy machinery on the ground floor has been damaged, as all is covered with debris. The machine shop on the south side has been left intact, and it is expected that in a few days the blacksmith and boiler shops will also be started up, enabling the company to resume work to a limited extent; still 250 to 300 men, out of the 500 men employed, will probably be thrown out of employment for some time to come. As to rebuilding, nothing has yet been decided, but the probabilities are that the damaged portion of the works will be rebuilt. At the time of the fire considerable work was in progress of construction. Among the orders on hand are orders for two marine engines; one was to be a triple expansion engine for one of the new ferry boats of the Hoboken ferry. The cylinders for this engine are to be 18½, 27 and 42 inches diameter, 24″ stroke. The boat is to have two propeller wheels, one at each end, the propeller shaft running the whole length of the boat. This design we believe to be a new departure in this class of naval architecture. The other engine is to be an ordinary compound engine, with cylinders 20 and 36 inches diameter and 26 inches stroke, and is designed for a whaling steamer.

## Machine Designing.

By Prof. John E. Sweet.

III.

In all our planning and all our study there is one vital principle that is hardly ever thought of and never mentioned. We all look for the best new machine, but who to see which is to be the best old one? The mathematicians tell us which is the most perfect gear, but all their calculations are based on a new one, and no thought given to the one half or three-fourths worn out. An engine cylinder needs no counter-bore when new, but experience has shown the necessity for it when old; and short crossheads, working on long slides without overlapping at the ends, soon wear the slides concave and themselves rounding, with the result, two curved surfaces of unequal radius always growing worse. The slides I will speak of later on. The gear tooth needs an undercut at the root as much as the cylinder needs a counterbore. The epicycloidal may be the best form for a new gear, and the single arc odontograph for an old one.

With the exception of the J. Morton Poole grinding machine, nearly every machine tool depends for the accuracy of its work upon the accuracy of sliding surfaces. In the best work special methods are adopted to make them true, after which they are left to fate to keep them so. Who has ever deliberately undertaken to plan and build a planing machine that should maintain perfect truth during its entire existence? The planing machine has a short table working on a long bed, the milling machine a long table working on a short bed—the lathe a short rest on long slides, and the shaper a long slide in a short guide.

The tool builder would laugh at the engine builder who should run a crosshead on guides not cut away so the crosshead would overrun at the ends; and yet he makes the sliding block on the cross feed of his lathe six inches long working on a dovetail two feet long, sometimes running off at one end and never at the other. The sum of the two fitted surfaces is thirty inches. If divided equally, that is, a fifteen-inch sliding on a fifteen-inch dovetail, the two would remain true and be a good job as long as the lathe lasted. This is one of the places where for lathes of moderate size there is no excuse for anything but wearing surfaces of equal length. The designer who finds any difficulties in this that he cannot overcome, has too little genius for the job. Equal length sliding surfaces can usually be employed in all the slides on milling machines, punching machines and many others, and wherever possible the use of any other arrangement is simply poor designing, to give it the mildest criticism possible. A short sliding block on a long guide invariably gets bad sooner or later, and refitting becomes necessary.

The sliding-head of a shaper invariably made longer than its guide, is an ever-present nuisance, and one that can be abated. The requirements call for a slide to work at all sorts of stroke, from an inch to a foot, and at positions varying as much as a foot. As now made, much of the back end of the sliding arm does not get a 100th part of the wear that the front end does, and often none at all. As a result in many establishments the thing may be worked for a year at short stroke and in one place; then when the attempt is made to use it in a different position, it is so loose in one position and so tight in another as to be worse than useless. The remedy is easy. Make the two sliding surfaces of a length and attach the connecting rod to an immovable pin, then both ends of the slide will always overrun, whether the stroke is an inch or a foot. To provide for the varying position of the cut, the plan shown in Fig. 3 is presented.

This slide is guided in the usual way and driven by a connecting rod rigidly attached to the side or bottom, as most convenient. Instead of the slides carrying a head and tool post, it is bored out, split and provided with two binding bolts, so as to grasp the tubular arm, which, when loose, may be slid or turned in any position, and then firmly bound in that position.

The diameter of the hollow projecting arm need not be much larger than the width of the tool holder—five or six inches—in an ordinary ten-inch or twelve-inch machine. The sliding arm being provided with a featherway and surrounded by a graduated worm-gear or ring feathered to it, the bar may be rotated to any angle, or, adjusted endwise without disturbing or losing the angle at which it is set. A second advantage of this arrangement would be the removal of the ordinary side projections which so frequently come in the way when using the present machines.

I have not presented this so much to represent an improvement in shapers, as to show how it is possible in machines of this class to use slides of equal length, maintain their proper position and get adjustment of tool. But you will say it is not so simple. True. Neither is a watch as simple as an hour-glass, nor a Corliss engine as simple as a Hero. Good things cost more than poor. All improvements have to be paid for. Sliding surfaces, such as those of the planing machine and slide rest of a lathe, cannot be of equal length; then the question arises, are they made to maintain their truth as well as possible?

The table or platen of a planing machine cannot be used successfully for its entire length unless the bed upon which it runs is longer than itself—usually about one-half longer—and when so arranged and used to any considerable extent on short work it wears the bed concave and itself convex to fit. This would occur even were both absolutely rigid, but is much aggravated by an elastic table, which may be sprung one way or another every time a new piece is secured to it. A rigid table with wearing surfaces so generous as to always float on the oil, however heavy the load, would keep true a long time, or if the wearing surfaces were cut away towards the end of the bed, as shown by this model (see Fig. 4), the result would be practically perfect. If the slide rest of a lathe be long enough, strong enough, has wearing surface enough of the right sort, and any man has courage enough to cut away the ways on the plan just shown, they would remain true for a time far beyond anything yet produced. And so with all slides; in fact, the principle can be applied to all wearing surfaces where, from necessity, a short piece must work on a long guide, or a short nut on a long screw.

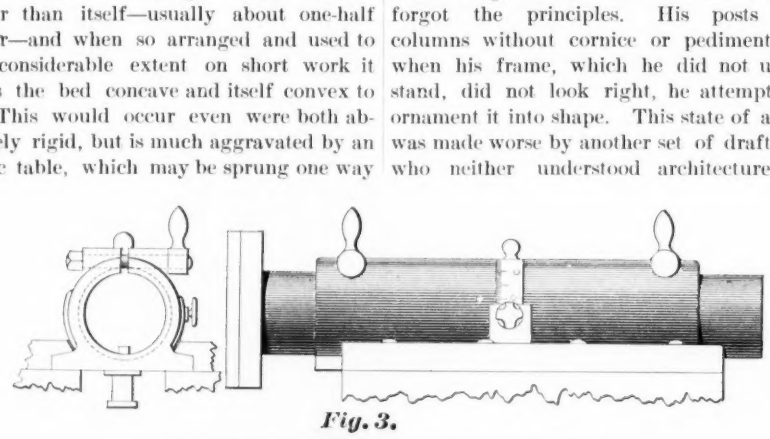


*Fig. 3.*

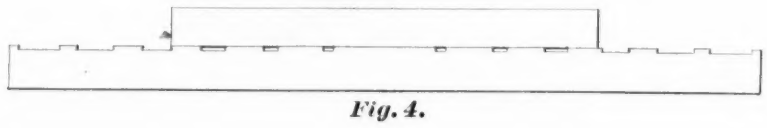


*Fig. 4.*

Journals with end play should have bearings and box of the same length; collars, or the bosses on wheels that resist end thrust on shafts, should rest upon or run against bosses of exactly their own diameter. The guides or slides of steam engines are as often too long as the crossheads are too short, for one is as fatal to enduring truth as the other.

I have used the best-known tools to illustrate principles that are employed in all machines; the assembling or combining the sliding, the rotary, angular and screw motions, is invention or design in proportion to the extent of originality. The construction of the framing calls for the exercise of many faculties; it must be suitable, strong enough, rigid enough (entirely a different quality), of such form that the patterns can be readily made, if to be of cast metal, so as to be easily forged, if of forging, so it can be machined; and last, but not least, so it will look right—in fact, lacking nothing but the poetry to be artistic. This looks, this artistic, this good or bad, this one thing that is past reason, this thing that we can't argue about, but feel, is that part that much more can be thought about than said; that part about which we may never be able to tell what to do to be right, and at most, but few things that may be depended upon as positively wrong.

Whatever nature does, she does right; whatever the designer does different from what nature would do if she had the same work in hand, cannot be right. Nature, at her best, roots her trees to the ground, tapers their trunks, and stretches out their far-reaching branches, but the branches all combined would not exceed the trunk in size; and the branches all grow out from the trunk on one and the same plan—never two or three growing up and then one down, as we find them in some late drilling machines, but all follow the same grand plan. If there is ever an exception to this in nature it is by distortion, a deformity, an abortion. There have not yet been so many good machines designed to call for an abortion for the sake of variety, for, in fact, there have been so many abortions that the good ones make the variety.

The causes that have been instrumental in producing such a large percentage of poor designs were these; our early draftsmen were architectural draftsmen; and when the aspiring mechanic required a drawing for his new machine he employed the architect, who brought with him his ornaments and forgot the principles. His posts were columns without cornice or pediment, and when his frame, which he did not understand, did not look right, he attempted to ornament it into shape. This state of affairs was made worse by another set of draftsmen who neither understood architecture nor mechanics, and lacked genius. Machines made from such designs have been scattered throughout the country, imitated and counterfeited, with their worst features made most prominent; cuts published in all the technical journals without a comment as to their merits or demerits in design; and now, to add to this, our colleges are going on from bad to worse by placing before their students models of motions and machines, constructed as machines never are constructed, or would not work if they were, and placing the students under a professor of drawing who teaches them how to make drawings rather than how to represent a properly designed machine, or teach them to know what constitutes good and bad designing.

The columns of all the best buildings in the world are straight—that is, their axial line. When their own weight is a considerable fraction of the whole weight, they have a considerable taper; when their own weight is but a small fraction, there is only taper enough to make them appear straight. I do not believe a computation was ever made to determine that this was right, but the designers were led to it by their own instinct. When the sides of a tapering column are perfectly straight, they will appear concave. This fact, known to the architects in Baalbec days, was remedied by making the lines curved just enough so the columns looked straight. Their imitators, discovering the fact without being able to appreciate it, did as imitators usually do, magnified their discovery and mutilated a design they could not appreciate.

Take the columns of the different orders and styles of architecture—Doric, Tuscan, Ionic, Corinthian, Norman and Gothic. No man at the present day will attempt to add to or take from in the hope of betterment, and yet the axis of every one is a straight line. No one of sense will ever attempt to improve them by making them crooked, because the straight line is right; and so with all the successful single-post machine designs—they are straight. It is true that George Richards, of Manchester, gives the sides of the post a noble sweep, but the axial line of the post remains straight.

It is true the supports of a machine are subject to oblique as well as vertical strains, while the columns of a building are not; but why do we fancy that a crooked member will resist those strains better than a straight one? The reverse curve is a line of beauty—yes, in an ornament, but in a thing, not, unless there is a constructive demand for such a curve. The outline of a Porter-Allen engine bed is a reverse curve. True; and it's also true there was no room for a straight one. The noblest architecture is grand because it is consistent. Our machine designs are noble in proportion to their consistency. Every feature of every noble style of architecture is conceived in the same spirit. Every feature of a Grecian building, its columns, its openings, its mouldings, itself, were in one style, and so of the Roman, the Gothic and the Norman; and every feature of a machine design should possess the same general characteristic. The Grecian and Roman columns were round, and for the service they had to perform round was the best possible form they could have. The Gothic columns are not round usually, because for carrying the arched ribs of the vaulted ceilings, clustered columns conform to the arches and best serve the purpose. In machinery, a square or rectangular form is best, because, usually, there are things to be added, and brackets or slides are most easily attached to a flat surface. The shape is consistent, and will never be improved upon. It is one of the things no Queen Anne fashion can overthrow. Fashion follows in machinery as well as in other things, and when it follows because it is the fashion, it is more likely to follow the bad than the good. All our older mechanics can remember when the posts of an iron planing machine were formed to fit various ogee curves—that so-called line of beauty. Does that form look well to anyone to-day? It has given way to the bold sweep of a single curve, which has come to stay, not simply because it looks better, but when rightly drawn it is right and looks right.

The true form is not a perfect parabola, however, because the case is not one parallel to the fixed beam loaded at one end. The planer post never gets its strain at the extreme end. We cannot trust to the mass of our mechanics to produce tasty designs, because the spirit of our people is not artistic.

The old form of framing and that used yet by the builders of cheap machinery, is *H* or *U* section—a style supposed to be strong because the mathematicians say an *H* section is a strong one, but it is no stronger in any direction than the box, and infinitely weaker when subject to torsion. The patterns are costly to make and easily broken in the foundry; there are no cores to make, but lots of mending up to do. Your city is not only blessed with good designers, but with good pattern makers and founders besides. I think if a Philadelphia designer should go elsewhere the first man he would send home for would be his old pattern maker, and the next the boss foundryman. One who has never tried it can hardly realize how little is the difference betwegn a graceful curve and an ugly one. The man who fails to discover this difference is the one who just fails, whether as a designer or pattern maker.

If an Englishman were set to improve the German design he would put in more iron; if the Frenchman, he would make the form more graceful; if the native Yankee, he would paint it green and stripe it with red; and to change this spirit, the example set by Philadelphia has done more than any other one thing, and it has not been so much by substituting steel-colored paint for green as the substitution of consistent things and forms, for inconsistent ones, and doing the thing that was to be done in the simple,

right way. This consistency comes, I believe, more from inherent common sense than education, and doing the thing right is more the result of good judgment than mathematical calculation.

It may not be possible to separate in our minds, very completely, machine designing from mechanical engineering, but in the sense in which I am endeavoring to devise rules for the one, I feel sure our colleges are entirely over-estimating the importance of the higher mathematics. When one has to use his judgment whether to give a factor of safety of four or ten, his judgment will tell him about how large to make the thing any way; and in another sense, where what Oberlin Smith calls the "anvil principle" becomes an element, the figures are entirely misleading. Or, take the case of the fly-wheel of an engine. It is impossible to begin to figure at all until you have guessed upon the first factor—that is, what per cent. of variation in speed will you accept? For absolutely uniform speed is an impossibility in an ordinary engine, and the extent of variation admissible is entirely guesswork. If you guess twice too much your wheel will be four times too small, and so you will be twice as likely to get it what you want, if you guess at the wheel and leave out the figures entirely. It is true that here and there mathematics are useful. In certain cases the higher mathematics are necessary, but usually arithmetic covers the ground, or a few marks on the drawing board, and the slide rule, is a much quicker way. When a class of forty students spends a good part of four years in learning the higher mathematics, with the certainty that at least thirty-eight of them will never have any use for them, and that the other two will forget a large part before the time for them to put them to use arrives, is it not worth questioning, the real value of so much application? "Discipline the mind" may be all very well when the mind is the thing that is to do the work, but where something is to be made the mind should never, in the sketch, the drawing or in the mathematics, lose sight of the *thing*, to worship the methods.

For the designing of buildings, the designers, architects, receive special training; for the designing of machines, with some stingy exceptions at our colleges, no training is had, and every man does it himself.

If anyone is to build a house he employs an architect to make a plan; if we are to build a machine, none of us think of employing a machine designer. I have known one exception to this. A manufacturer bought a patented invention, with nothing to show what the machine was to be but a wood model—crude in every element. He employed a man to get up some drawings of it, and with the instructions to "put it in shape." For the drawings and the putting it in shape he paid $25, and the result has been quite a fair fortune. If manufacturers would employ designers when they have machines to design as they would architects—I mean real designers, not simply draftsmen—I believe they would find it an equally profitable investment. This would in many cases cost considerable, because competent designers are scarce, and the reason they are scarce is because, aside from the special gift, the necessary requirements are so varied.

Besides being every inch a mechanic, saturated with the courage to do things new, and right, one needs the genius of an inventor, the training of an engineer, a knowledge of architecture, the experience of a manufacturer, the skill of a master mechanic, the handicraft of many tradesmen, and the spirit of an artist.—Reprinted from the *Journal of the Franklin Institute.*

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A plan for testing the resistance or supporting power of the soil has been adopted on the grounds of the forthcoming Paris Exhibition, which it seems to us might be used to good purpose in many cases, where it is proposed to erect buildings or other structures of importance.

Four rectangular blocks were placed upon the ground one at each corner of a square, the side of which was about 12 feet; these blocks were then gradually loaded with iron Ts until they were forced into the earth, the load and the amount of depression being carefully noted at various stages. From the data thus obtained the weight per square foot which the soil was capable of bearing was definitely determined, and from this the proportions of the necessary foundations were calculated.

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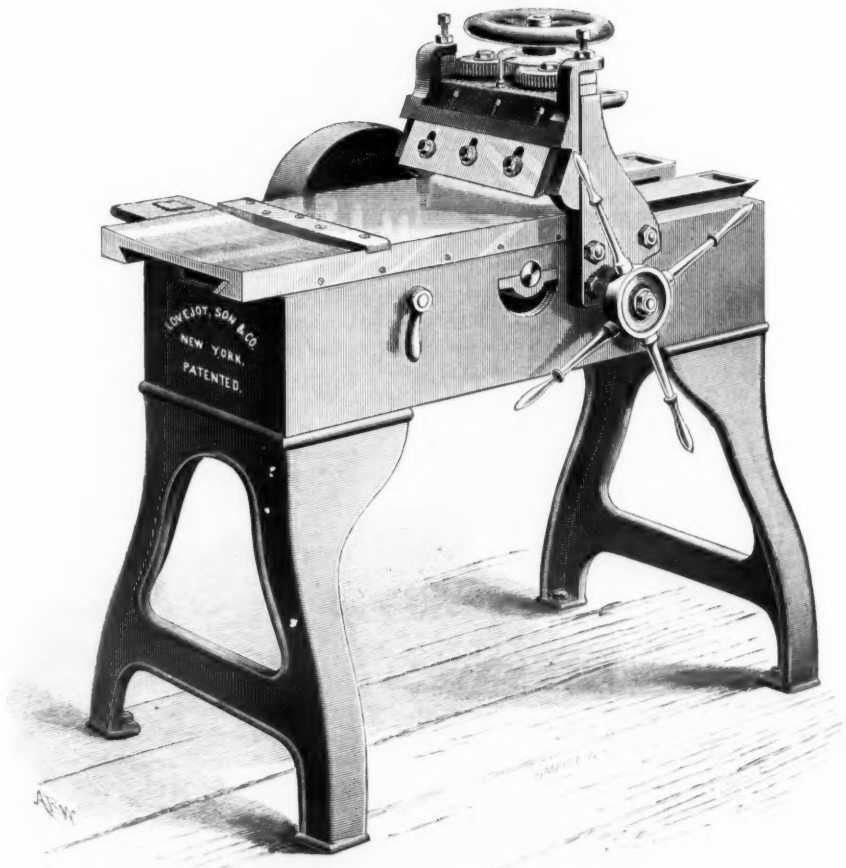
## New Electrotypers' Shaving Machine.

The accompanying illustrations show two sizes of machines used by electrotypers in shaving off the bottoms of electrotype plates.

FIG. 1.




ELECTROTYPERS' SHAVING MACHINE.—FIG. 2.

These machines differ from the ones usually employed for the purpose, in having a bed which moves under a fixed knife instead of a stationary bed with a knife mounted upon a sliding carriage—a construction which avoids complication and secures rigidity and power.

The driving mechanism for moving the bed is very simple, consisting of a worm upon a longitudinal shaft (Fig. 1) working into a worm-wheel, upon the same shaft with which is the pinion, which meshes into the rack on the under side of the bed. The worm, worm wheel and pinion, are made from steel castings. The end thrust of the worm wheel shaft is borne between two collars, one of which is fast to the box next the pulley and the other on the shaft; these collars are conical, and between them are little conical rollers which receive and transmit the thrust with very little wear or friction.

The worm is connected and disconnected from the wheel by the short lever at the right of the operator shown in Fig. 2. Power is applied to move the table in one direction only, the backward motion being given by the hand wheel in Fig. 1 or the pilot wheel Fig. 2.

It will be noticed that the bed is extended out beyond the strip against which the plates are placed, to give increased length of bearing, as well as to bring the short plates, which are usually much the most numerous, into the middle of the bed, and so secure uniform and well-distributed wear upon the sliding surfaces. The upper surface of this extended portion is concave, and makes a convenient place on which to straighten the plates before shaving.

The knife is quite heavy, of solid steel, and ground true on the front and back surfaces after being hardened, and as the surface against which the knife is bolted is also made true, the operation of setting the knife is quite simple, there being no liability of springing the parts in tightening the bolts.

At the left of the machine is an inverted plane, by which one edge of the plate may be beveled off for the knife to start on. In front of the bit, which is in this plane, is a plate which is hinged at one end and held up above the bit by a spring, thus avoiding all danger of the operator cutting his hands; but when a plate is drawn over the face of the plane this spring yields and allows the plate to come into contact with the bit.

The machine shown in Fig. 2, besides being larger, has means for raising and lowering the knife by means of two elevating screws, connected by gears with the hand wheel, as shown. To the hub of this wheel is fixed a graduated index plate; which enables a fine adjustment of the knife to be made, and the sliding head is extended upwards and over the housings, and has two set screws, which come into contact with distance, or gauge pieces, as shown. By removing or inserting these distance pieces the knife can be readily changed from one definite height to another, as when changes are made from the thickness of plates which are to be backed by wood, to those which are solid metal, type high.

The makers of these machines, Lovejoy, Son & Co., of New York city, carry on a business of stereotyping, and the machines are the outgrowth of their experience with their own work.

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## LETTERS FROM PRACTICAL MEN.

### Lubrication.

*Editor American Machinist:*

In the April 2 issue of the AMERICAN MACHINIST, Mr. Rogers makes some very good remarks on the care of machinery, as far as he carries it. I will, however, in this, confine myself to the matter of lubrication—a very important matter to be looked into by both machinery manufacturers and machine operators. The trouble Mr. Rogers cites may be, and often is, the fau't of the operator in not giving proper oiling, and especially so when a new machine is started. But I have seen new machines started with all the possible care taken in this direction with a similar result. Here the fault reverts back to the manufacture of the machine, in that, that due provisions were not made for proper oiling. It is surprising how many machine tools are put upon the market with merely a small hole drilled into the bearing without even an oil channel cut longitudinally therein, to convey the oil to the extremities of the bearing, and again those who have made an attempt in this direction have made the grooves so very small that they amount to very little, especially after being in use a short time they will soon fill up, and if the bearing is close fitting the oil will not flow unless a vent is provided at the ends. The proper plan is to make large and deep grooves, so that they cannot fill with gummed oil and dirt, at least not for a long time, and thus prevent the oil getting all over the bearing.

It is a frequent occurrence about the machine shop to see a machine here and there stopped from work to be torn apart, and with a sledge and piece of babbitt metal—an extravagance in itself by the way—drive out a shaft from a solid box or a pulley, firmly held together by abrasion, all for the lack of oil at proper place and proper time. An examination in nearly all cases reveals the trouble to have been caused by improper oil passages (sometimes, however, it is gross neglect of the operator). Let us have a large oil hole, a good sized oil channel to the extreme of the bearing with a little vent, so the oil is sure to flow; then, by due attendance of the operator in oiling at the proper time, we may reasonably expect no difficulty.

What is better than this is constant lubrication, both for sureness and thoroughness and economy. With the oil can we squirt enough oil in at one time to last half a day or even a day, but it runs through the bearing and is wasted, and to insure no trouble it must soon be repeated; and especially is this the case with high speed bearing. This causes a great deal of waste of oil and less life to the bearings.

The best method is to use the drop sight

feed—on such bearings, at least, if not on all of them—and the proper amount of oil can be supplied constantly, thus insuring thorough and constant lubrication without any trouble in the bearing, or any waste of the oil. This was clearly illustrated to me by a spindle running at a very high speed with hard boxes. I had large oil channels, and the oil could flow freely to all parts of the bearings. The result was they required frequent oiling, and before one could think of it the bearing would begin to abrade and often stop. The application of the drop feed overcame the whole trouble, and that was applied little by little, just enough and no more, and at the proper time, and the oil required by the method was many times less.

Let us have large oil holes and large oil grooves terminating at the ends of the bearing in a mere vent, or in as many cases as possible use a constant oil supply, and I am sure that all the trouble by lack of lubrication can be overcome. A. B. Landis.

### "Copying Machine Designs."

*Editor American Machinist:*

We have read with considerable interest your leading editorial on "Copying Machine Designs" in your issue of April 28th. There is not a manufacturer who leads in his particular line of business but what suffers from these copyists, who "live and have their being" only by appropriating to their own uses the inventive ingenuity of responsible manufacturers, who have spent many years of hard labor in the production of high class tools and machinery of recognized merit. These copyists rarely, if ever, advertise, and never publish their machinery in mechanical papers; their business is done by the use of circulars, and sometimes through personal solicitation. Originators and reputable builders cannot compete in *price* with copyists who build machinery, the only merit of which is cheapness.

Users of machinery and tools are to a certain extent responsible for the existence of copyists. A short time ago a very large concern of acknowledged responsibility allowed one of these copyists to enter their works and take sketches and exact dimensions of a machine designed especially for their use, to reduce cost of production. This large concern permitted this, because they did not want to pay the originators of this machine their price for the second one. Their first machine worked splendidly and effected much saving, and yet they were willing to allow this copyist to enter their works for dishonorable purposes, and run the risk of obtaining a poorly and imperfectly constructed machine.

This is altogether wrong, and should not be permitted, under any circumstances. Originators should be protected at all times by their customers, and purchasers of machinery and tools will find it greatly to their advantage to give workmanship and merit the first consideration, rather than cheapness of price. Progress.

### A Boiler Difficulty.

*Editor American Machinist:*

In the American Machinist of April 7th, Mr. W. H. Booth refers to my letter on the use of castor oil in boilers to check priming. I am glad he has referred to the letter in the way he did, for I have learned something I did not know, and that is what I read the American Machinist for. I have known for some time that large quantities of grease were injurious to a boiler. But I did not think there would be any danger in using castor oil if the boiler was kept clean.

Now as Mr. Booth condemns all grease in boilers (except mineral oils) I would be glad if he would give us a remedy for the evil I spoke of. I have tried cleaning out boiler and water tank both, start on fresh water and have good results; then again I would be in as bad a fix as ever in twenty-four hours. Then I have tried blowing down as low as was safe and pumping up fresh water, and tried low water and high steam, which at times would answer the purpose. Then again I would be completely beaten, and so the castor oil filled a long felt want with me.

Mr. Booth commends my remarks on blowing out while hot, for which I am proud, for I find engineers much older than myself that do not consider that of any importance and will draw the fire or let it cool down some, and then open the mud valve, and, as they say, to blow out the mud, but I think if they will open the boiler they wil find most of the mud there.

B. W. Benson.

### Lining Up Lathe Spindles.

*Editor American Machinist:*

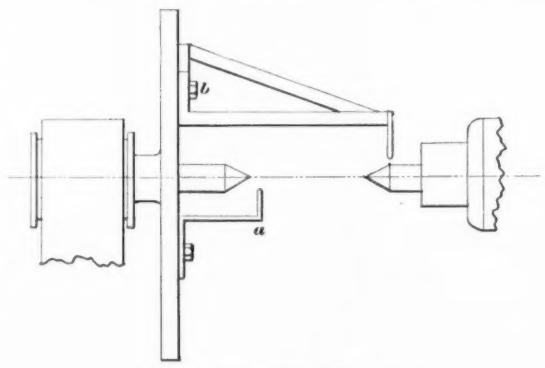
The subject of setting a lathe to turn straight, and also of making the alignment of the live spindle perfect, is one over which much serious thinking has been done by almost every machinist, and to which much importance is attached in every well-regulated shop.

The device given by your correspondents B. and F. (which I think has appeared in the Machinist before) will, unless the joint is very perfect, be liable to mislead the best of us, inasmuch as a very noticeable variation may occur when transferring the tram from one end of the work to the other end, which I proved some years ago by experience.

Inclosed I send sketch of a device, which I saw and used when working at the B. W. Payne & Sons' shops at Elmira, N. Y. It consists of two trams *a* and *b*, which are to be bolted to the face plate of the lathe.

The short-armed tram is made of iron or steel, and the long-armed tram of wood, with a steel pointer or needle.

To set the lathe to turn straight, bolt the short tram *A* on to the face plate, then slide




Lining up Lathe Spindles.

the tail stock till the centers almost touch, then set the tram to touch on one side of the dead center, when, by turning the face plate, a glance will show which way to move the center to bring it in line, and it will also show at once to what extent the live spindle has dropped or worn down, if any.

To line up the live spindle, two trams must be used. First the short tram (as directed), and then the long tram. It will be found that the spindles of any lathe can be set in line with great precision with these trams in the hands of a careful workman.

While on this subject I might say that it would be as well to try the alignment of the tail spindle, as it is the live spindle; as in my practice I have found more than one tail spindle out of line, and in one instance I got into disgrace with my foreman for asking him if the tail spindle was intended for a taper-turning attachment, as by screwing in or out a difference of $\frac{1}{32}''$ in 6″ was the result. But in justice to the tool builders I would say that the lathe had been built under the direct supervision of said foreman in the shop. John T. Usher.

Davenport, Iowa.

### Labor-Saving Machinery.

*Editor American Machinist:*

Allow me to ask for some of your space to amplify your recent editorial note on the subject of labor-saving machinery. Your position is undoubtedly the true one, and deserves further discussion.

It is an important fact that our economic relations to our fellow men are frequently the exact reverse of what on the surface they appear to be; that the true interests of the individual in such matters are often exactly what in appearance they are not. Labor-saving machinery is a case in point. The opposition to it can at least be understood, for on the surface there is an appearance of truth to the charge that it "takes the bread from workingmen's mouths." I say an appearance of truth, for nothing is more certain than that, in fact, it does nothing of the kind; that what comforts the workingman has to-day he owes to it, and that his hopes for greater comforts in the future depend chiefly on its further extension. We are all familiar with the stories of the greater comfort of existence to-day over that of the years gone by. We have all heard it stated over and over again that the necessities of to-day were the luxuries of that time, and that comforts that are to-day enjoyed by all, as a matter of course, were then beyond the reach of any but the most wealthy. Now this change of affairs is due to labor-saving machinery, and this not partly nor mainly, but wholly and entirely. It has brought about the change by the fact that it has lessened the cost of production and made things cheaper. Consequently, those can now buy who formerly had to go without.

The opposition to labor-saving machinery springs from two fundamental errors:

1. The workingman is considered as a producer only, the fact that he is a consumer as well, being overlooked.

2. Consumption is regarded as a fixed quantity; it is considered that there is a certain fixed amount of work to be done each year, and that the more work any one man does, the more men will have to go idle for want of something to do.

The fact is that the workingman is a consumer; that is, he eats food, wears clothes, burns coal, etc., and it is to his interest to buy these things as cheaply as possible. It makes but little difference to the millionaire whether his shoes cost him three dollars a pair or thirty; or whether he pays ten dollars a suit for his clothes or a hundred; but to the man who has to earn his living these things do matter; and labor-saving machinery, by lessening the cost of what the workingman has to buy, works to his benefit, and not to his injury. An example will illustrate this. I recently heard a native of Bulgaria deliver a lecture on the life and customs of his native people, and among other things, he stated that among them it was the custom for the men to knit their own stockings. On one occasion he tried himself in this accomplishment, and found that by getting up early and going to bed late, he could knit a pair of stockings in two entire days. Now of course he might have hired some one to knit his stockings, while he worked at some other occupation to earn the money to pay for them, but he would have had to pay the knitter two days' wages, which, in the long run, would have balanced his own for the same time.

That being the situation in Bulgaria, how does it compare with the state of things here? An American mechanic, with the proceeds of a single hour's labor, can buy a pair of stockings that will wear until he is tired of them. Now this difference is due to labor-saving machinery, and to nothing else whatever. In Bulgaria it requires two days' work to knit a pair of stockings, and it costs two days' wages to buy them. In this country it requires but a fraction of a day to knit them, and they cost but a corresponding fraction of a day's wages to buy.

It is characteristic of human nature to accept matters as we find them, and to consider that the condition of things to which we were born is the natural one, to which there could have been no reasonable objection; hence we read, with a smile of complacency, the stories that are told of the furious opposition to the inventions of the past—the opposition of boatmen and sailors to steam navigation, of stage drivers and teamsters to the locomotive, and of weavers to the power loom. And yet that opposition had the same basis and the same arguments as the opposition to the inventions of to-day. The boatman saw in imagination a single steamboat absorbing the business of half a dozen sailboats; the truckman saw his occupation absorbed by the railroads, and the weaver saw one man running power looms, doing the work of a dozen with hand looms, and each said to himself, "Where are the men who are displaced to get work? We cannot compete with steam and iron; these things must be destroyed or we shall starve."

The boatmen and stage drivers thought that there was a certain number of people who made a journey each year, and that the steamboat and railroad, by carrying these people with less labor than stages and sail boats, would throw them out of employment. They forgot that there were thousands who would like to travel, but who did not do it, because of the expense and trouble, and that improved methods, by lessening the expense, would enable them to gratify their wish. The weavers thought that there was a fixed amount of cloth to be made each year, and that the power loom, by making it with less labor than the hand loom, would throw them out of employment. They forgot that there were thousands of people who wanted more and better clothes, but who could not have them because they cost so much, and that the power loom, by cheapening cloth, would enable them to gratify their wish. Before the advent of the power loom, woven fabrics were a luxury, used "every day" by the rich only, while workingmen were largely dressed in leather; but that invention, and others related to it, have so cheapened the cost of fabrics that clothes of cloth are now worn by all as a matter of course, and the consumption has so increased that more people are to-day employed in cotton and woolen mills than ever before in the history of the world. Meanwhile, however, we have all forgotten what we owe to the labor-saving power loom, and many are opposing its further improvement, believing that it would "take the bread from workingmen's mouths." Similarly, the steamboat and the railroad have so cheapened travel and transportation as to benefit all beyond measure, and both travel and transportation have so increased, that the railroads employ a score where the old methods could have found work for one. Such illustrations could be multiplied without end, and they would only show that it always has been the case, and always will be, that cheapened production is followed by correspondingly increased consumption.

Our disposition to accept things as we find them, but to oppose any further change, leads many to admit the benefits of the past, but to think or fear that we have now reached a point where the advantages of the process would stop. The long list of things which every man wants, and which he would buy if he could afford it, ought to convince every one that the stopping place has not yet been reached. Is there one of your readers who would not buy more and better clothes than he now does if better ones cost less money? Is there one who would not furnish his table better if food were cheaper? Is there one who would not furnish his dwelling better if furniture and carpets and pictures cost less? Finally, if he were supplied with all these necessities to his heart's content, is there one who would not spend more on amusement and recreation than he now does, if he could spare the money from more necessary things? There is but one answer to all these questions: We would all buy more of all these things if they were cheaper; in other words, consumption is not fixed, but is limited only by the capacity of the people to buy. There is no limit to the goods that can be sold, provided they are sold cheap enough. Now, labor-saving machinery, applied to the production of these various articles, will cheapen every one of them, and enable every man to have more of them than he has now.

Perhaps the climax of this opposition was reached when recently the hod-carriers of a neighboring city went on strike in order to abolish wheelbarrows from their work. This may provoke a smile, but the hod-carriers were more logical than some who will laugh at them. A man can carry more bricks with a wheelbarrow than without, and the barrow is a labor-saving tool in the

same sense as the new-fangled steam hod-elevators of the day, or any of the latest machinery of the sash and blind factory; and the logic which opposes one applies with equal force to the other. Suppose this demand were acceded to throughout the country, and that wheelbarrows and all other labor-saving appliances were abolished from building operations. The successive results can be set down in a table, thus:

1st. More men would be employed temporarily in putting up the buildings now under way.

2d. More labor being necessary, these buildings would cost more.

3d. The cost of buildings having increased, fewer new ones would be erected.

Meanwhile:

4th. Buildings costing more, rents would advance.

5th. Rents having advanced, fewer houses would be rented. Some who now keep house would then board, and some who now rent four rooms would then get along with three.

6th. Fewer houses being rented, still fewer would be built, and hence

7th and last, from 3d and 6th, fewer houses being built, fewer men would be employed in building them.

Now, who would be the final loser? Not the capitalist, for he would get the return for his increased outlay in the increased rental. The workingman, however, with no better employment than before, would either crowd himself into smaller quarters or pay higher rent, and in this he would simply pay the penalty for his blindness to his own interest.

One other aspect of the case applies with special force to American workmen. Export trade is one of the chief sources of prosperity to any nation. It needs no argument to show that it increases the amount of work to be done. Now that nation will sell the most machinery and other products, which can sell the cheapest. I am glad to believe that the American workman is better paid than others; but if we are to have an export trade, he must expect to do more in proportion. If wages here are higher than in England, and we consume as many days in building a given machine as England does, then England will be able to sell that machine cheaper than we can, and South America and Australia will buy of her, and not of us. If, however, through labor-saving machinery, we consume less time in making the machine than England does, then we can sell as cheap or cheaper than she can, and thus build up a foreign market, and at the same time pay the present scale of wages. We export watches, sewing machines, and fire-arms to all parts of the world, because in their manufacture we have developed labor-saving machinery to a higher degree of perfection than other nations. Other manufactures we export to a small degree or not at all, because we have not applied labor-saving machinery to their production to a sufficient degree to enable us to compete with the cheaper labor of Europe.

Finally, I have used the word workingman in its usual sense, though against my will. I know of no line of distinction among those who render to the world an honest equivalent for the living they get from it. Labor-saving machinery benefits all alike, save only those who do not need its help.

FRED. A. HALSEY.

## Street Car Propulsion.

At the Fulton Foundry, on Furman street, Brooklyn, may be seen, nearly completed, the machinery and car mechanism for a cable road that differs very materially from any system at present in use. The system is the invention of A. H. Mathesius, well known for his connection with the construction of the cable system of the Brooklyn bridge.

The new system is called the "covered tube" system, from the fact that the tube for the cable is, except immediately under the car, at all times closed, presenting no obstacle to other travel, and doing away with the nuisance of the open slot, and consequent accumulation of dirt and snow in the conduit. As the car moves along, the sections that form the top of the tubes are opened to the right and left by ingeniously arranged mechanism, and as the car leaves a section it is closed, the opening and closing movement being gradual, and arranged to operate without shock or jar at high speed. The opening and closing mechanism is ingeniously adapted to accommodate itself to curves.

Very complete provision is made for mechanically dropping and picking up the cable, should it be necessary, at any point between the terminal points of the road, and the construction of the grip is such that the car may be run at any speed less than that of cable, without slip and consequent wear of the latter.

There is nothing in the construction of the covered tube that prevents a car from being removed bodily from the track, if necessary, at any point in the line.

The carrier sheaves are made in five sections, the three center sections being loose on the spindle; this avoids the ordinary slippage and wear of rope. These sheaves are small in diameter, and are run on friction rollers, to reduce the friction to a minimum. There are many other novel features of the machinery and mechanism that will bear examination by those interested in street car propulsion.

All the details of the system are well worked out, and particular attention has been given to ease of manipulation and certainty of action.

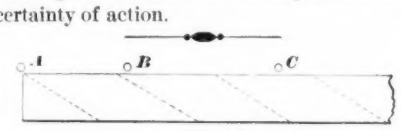



*Fig. 1.*

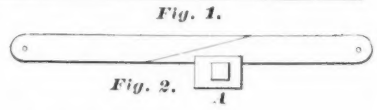



*Fig. 2.*

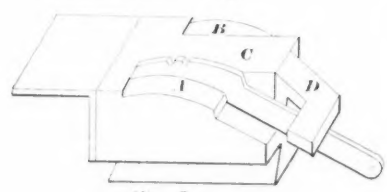



*Fig. 3.*

## Details of Blacksmithing.

BY B. F. SPALDING.

AGRICULTURAL WORK—SEEDER POINTS—TREATMENT OF AGRICULTURAL STEEL.

One of the first agricultural implements to be used in the spring, as it is the last to use in the fall, is the broadcast seeder, which is used for sowing grain, and by many is preferred to the drill, because it does not deposit the seeds in close juxtaposition, but gives to each a snug little place of its own, like the houses in the country, while the drill lays them in rows, like the buildings in a city. The seeder point is a diamond-shaped piece of steel which is attached to a shank, and on that is pendant to a beam, and its use is to scratch furrows in the ground, irritating it, after the fashion of a harrow, and making a broken and loose surface, in the little crannies and interstices of which the seed grain can make secure lodgment. These seeder points are about 6" long, measured from end to end, and 2¼" across the short corners. The shanks, which connect them with the frame, are of iron, and to these they are sometimes welded, and sometimes fastened by other devices.

In large agricultural establishments, where a great variety of work is manufactured, every special class of work has naturally its allotted season if the business is well regulated and properly managed, and this feature affords permanent employment to the workingmen. It is not, however, as favorable to the maintenance of special tools for particular purposes, as the manufacture of greater quantities of fewer kinds, hence whatever special tools are employed should be of a kind that can be readily brought into use when wanted, and as readily retired when their work is completed; or they should be such as can be readily converted from one use to another, as occasion requires. The special tools, therefore, should be in the form of dies and formers, adapted for use by attaching them to the general running machinery; and in the blacksmith shop the furnaces and forges should be so divided as always to have all the forges needed; for it must be remembered that quite a good furnace can be improvised on a forge, while much of the work which can handily be done on a forge cannot be done on furnaces, except they be of special construction and design.

The seeder points were cut off from bars of steel 2" x 1½" with a flat, straight shear, as shown in Fig. 1, the bar being shoved up diagonally to the shear, and kept against the gauges *A B C*, while the cuts across were made successively, as shown by the dotted lines.

The shanks were prepared by cutting 1⅛" x ⅝" iron into pieces long enough for two shanks, or what is better, having it come from the mill already cut to length, and then splitting them diagonally across, after rounding the ends and punching the holes which are to be used to hold them in place. The simplest form is illustrated at Fig. 2.

The long diagonal cut is gauged from the hole, in combination with the piece at *A*, which is a "hold down" as well as a gauge, and is made quite strong, because any "give" or "let up" is straining on the press, as every one can infer, who has ever used a pair of hand shears. The parts—plate and shank—are now ready to be welded together, except that by shearing the shank it has become a little out of square, and a slight heat is taken to remedy that defect. The plate is now laid on the shank, and the two are held together in their proper places by a pair of tongs, which have been made quite heavy to resist the heat, and are of the proper shape to seize the shank and plate and hold them together at the back, while a heat is taken on the points to stick them together. After the points are stuck the heat can be safely taken along the whole length.

Nothing has been found that made as good a flux for the purpose as borax, and that is freely used. There is no attempt to make round corners along the sides, where the shank comes down on the plate. It is simply laid upon the anvil and welded on, without regard to cold shuts. The narrow, or edge part of the shank, which is one of the surfaces brought into the union, being of the softer material, and the wide or flat part of the plate being of the harder material. The shank being iron and the plate steel, there is not so much danger of the shank driving into the plate as there would be if these conditions were reversed; but the unscientific nature of the joint frequently shows itself when the piece is hardened, by exhibiting a crack on one or both sides, which ruins the work, and makes it necessary to knock off the old and weld on a new plate. This happens in from 2 to 20 per cent., according to the skill of the workman and the quality of the steel and fuel. Notwithstanding this fact, the object of the operation is of such slight importance that perhaps it would not be expedient to prepare the shank for welding in the shape which good forging requires. A quick workman will weld upwards of 200 in a day. All kinds of botch jobs are certainly to be execrated, but are there not some cases where jobs can be done cheaply and yet answer the purpose just as well as though they were done in a way which would be, in other respects, much better, but which would be much more expensive? And if there are such, is it not allowable to do them in the cheapest way? There are some good blacksmiths who would quit work rather than do work in this manner, and there are a good many more who would do the job but would quit before they would stamp their names on it. Of these the last are most justifiable. Probably any jury of good workmen would decide that it is an undeniable case of malpractice. Bad as is the plan, however, the work itself can be well done, and no less than a hundred thousand seeder points are scratching dirt this spring that have been made in just that way.

Some of the shops welded them under the drop. To do this an impression was made in the bottom die, into which the plate would fall freely, and back of this were raised lugs, which were for the purpose of guiding the shank into the right position. A heat was taken on the plate, by laying on top of the coke in the furnace, and one on the shank, hotter, by putting it into the coke. The plate was boraxed, and when hot let fall into its place in the die, and the shank, guided by the lugs, was laid in the right place on top of it and the drop immediately let fall. This plan, if rightly carried out, will make as good a job as one need ask for, because the top die can be recessed to take in a limited amount of stock, and the instantaneous blow of the drop will weld the surplus thrown out, as a fillet, down solid onto the hot plate.

In whatever manner these were welded, the operation of hardening was attended with some risk, the plate being so thin, and having the thick narrow back rising from it, which made it impossible to cool it uniformly. The process which gave the best results in practice was to heat them to the proper heat for steel of about ⅝ of one per cent. carbon, of an inexpensive kind, and then coat them with cyanide of potassium and place them in clean cold water in such a manner as to cool off the shanks, and as soon as the blackness of cooling off the shanks began to show itself in the redness of the faces the whole thing was submerged in the water. They were supposed to be hard enough to cut glass, but occasionally one could be found which was not so hard.

It will be noticed that although the diamond-shaped plate had two points, yet by this method of attaching them to the shank, only one of them could be made available for scratching dirt. This led to the invention of a reversible point, which was a great improvement; so much so that if the inventor had received only one-tenth of the benefit derived from its introduction, he would have become wealthy. The plate of this point was made like the other, except that the steel was 5/16" instead of ¼" thick, and on it was riveted a malleable iron back or socket, of such shape as to admit the shank from either end, and thus, after one point had been worn off, the plate could be turned around, and the other point was still to wear. The shanks were fastened in by a little square pin, which was driven in a hole through the side of the socket into a notch, which was formed on the side of the shank. These shanks were made with the shears in the same manner as the others had been, with the addition of one operation, which was to cut off the point to a certain length. The lower die for dropping these was made as shown at Fig. 3.

The shank, after being heated in the furnace, was put into the die at *A*, being kept from flying up when the bend was made, by the "hold down" shown at *D*. It was then laid flat on the face *C*, and struck one blow, when it was removed to *B*, where it received the blow which impressed the two notches from the form of the upper die. It was again laid on *C*, and struck flatwise, to take down the burr from the indentations, and once more on *A*, to make sure of the set; then it was struck on *C*, a blow on the point, and another on the heel, to straighten it, and pushed off, on to the pile in front of the drop, finished. The seven blows were struck without stopping the drop, the dies working free enough to catch every blow.

The hardening of the steel plates was done after there had been two rivet holes punched, and countersunk, and they had received a slight curve. They were heated as near as possible to what was found to be the proper degree of heat, each lot being experimented with for this purpose, and then one end was dipped nearly to the middle and chilled, and then the other end was dipped in the same way, leaving some heat at the center, because the presence of the two rivet holes weakened it at this point, and it would not bear to be left as brittle as it would be if it was chilled.

Other lots required to be treated by other plans. They were made hot and coated with cyanide, and thrown into oil, from which, when cold, they were taken and rattled, and then laid on bars of hot iron until the color could be seen to start in the middle.

It has been remarked of some of the newer or later metals which are sold as steel, that as soon as they are heated hot enough to show any color all the temper is gone. Tempering in oil was the safer method, as there was little danger from fire cracks. But let no man flatter himself that he can take two pieces from a large lot of agricultural steel, and treating them in the same manner, be sure of producing the same results.

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## The Influence of Surroundings.

There is considerable comment by our exchanges upon the curious case of an engineer on one of the Ohio roads, who had been found to be almost entirely deaf, and had been discharged in consequence, but who afterwards proved that when on the road, running his engine, he could hear quite well; in fact, decidedly better than the physician who examined him, and he was reinstated.

It is a strange case considered by itself, and yet we are not surprised at it, for the reason that many similar cases might be mentioned by those who have had much experience in shops. A majority of boiler makers who have worked at the business for any considerable length of time are quite deaf outside of the shop, but in the boiler shop, where any one not used to the noise would hardly be able to hear the discharge of a cannon, they hear ordinary conversation with ease. We know of a time-keeper in a large establishment, who, when out in the shop, hears fully as well as any one, and it is only when he is spoken to in his office, or some other quiet place, that it would be known that his hearing is affected.

We do not know the reason of this phenomenon, but it would seem that the organs of hearing have the power of accommodating themselves to their usual surroundings, after which they perform their functions best among those surroundings.

The eyes seem to be capable of the same thing, and many a locomotive engineer has been deprived of his engine because he was declared to be color-blind after being tested by some scientist with bits of colored yarn, yet who, during years of experience on the road, had never failed to instantly recognize the color of any signal used upon the road, and who, if the test for color blindness had been made on the road, under conditions in which he had been accustomed to distinguishing colors, would have recognized them far more quickly, and with a far greater degree of certainty, than the scientist who conducted the test would be able to, under the same circumstances.

## An Inquisitorial Department of Government.

Among the bills recently passed by the National House of Representatives, is one to establish a Department of Labor, to be under the management of a Commissioner of Labor, appointed by the President, and which is to examine into and report upon pretty much everything directly or indirectly related to the labor question. Among other matters, the profits of manufacturers are to be looked into and reported upon.

We wonder just how much real information will be obtained regarding the profits of manufacturers by this proposed new department of the government?

Fully as much as there ought to be, we have no doubt. But how will it look for the American government to send its agents to the manufacturers of the country to ask them all about their private affairs—how much it costs to produce the articles manufactured by them, and what their profits are, etc.? We do not think they would find out much in that way, neither do we think they ought to find out much. And even supposing that they found out all about it, what good would it do? How would labor be benefited by the possession of such knowledge by the government?

Is the government to step in and decide how much profits manufacturers are to be allowed to make, and dictate what rate of wages shall be paid?

We do not think the cause of labor is to be benefited in any such way, and the probability is that the majority of the congressmen who voted for the bill are of the same opinion.

We should have much more hopes of the beneficial effects of a governmental inquiry into the methods of doing business and the profits made by the various individuals and combinations who (by the assistance of the government in many cases) are enabled to pocket millions of dollars produced by the labor of the country, to the production of which they have in no way contributed at all, and which really amounts to a fine imposed by them for the privilege of living and laboring, to produce values.

Some time ago we commented upon the findings of a commission which investigated the causes of an English railroad wreck, it having reported that, previous to the wreck, the engineers of the trains which collided had been on duty nearly 18 hours, and that, in its opinion, these unreasonable hours of service were the chief cause of the collision. But by the evidence taken before the Railway Commissioners, regarding a recent wreck at Creston, Ia., on the Burlington road, it is shown that the conductor of the wrecked freight train had had no sleep for *fifty* hours, and that he objected to going out without rest.

No management of a railroad company needs to be informed that there is no security against fatal mistakes being made by men who are treated in this way, and it is a case of sheer recklessness, and if the purely selfish considerations involved are not sufficient to prevent such gross imposition upon railway employes, then the public should, for its own protection, secure the enactment of laws inflicting severe penalties for cases of such utter disregard for their safety.

In the case of the English accident we had the pleasure of announcing, shortly afterwards, that it had led to an order limiting the number of hours of continuous service to something like a reasonable time, on that road.

It is to be hoped that a similar effect may be brought about by this one, but if not, then the law-makers should attend to it for the protection of the traveling public.

We have not—as we now remember—ever before had occasion to chide our bright contemporary, *The Jeweler's Journal*, for the crime of taking what did not belong to it. We are loath to do so at this time, but our sense of propriety, and the hope of doing good, impels us to say that the article published in its editorial columns in the issue of April 21, under the heading "The Struggle for Naval Supremacy," was taken bodily, without credit, from the AMERICAN MACHINIST. We trust our contemporary will not consider us captious in mentioning this. Possibly the editor was not at home when this occurred. We hope he was not.

Among the curious machines recently patented, is one by a Newark, N. J., man, which, when you step upon a platform and deposit your nickel in the slot, indicates your weight upon a dial, soothes your savage breast by music, and prints for you a slip certifying your weight. Two patents were granted upon it, one of twenty-one claims, and the other of forty-six.

Our exchanges are giving prominence to schemes for a substitute for copper. What the world really needs is a substitute for the syndicate which corners and controls the output of copper; nothing more than this is needed.

## Literary Notes.

AMERICAN STREET RAILWAYS: Their Construction, Equipment and Maintenance. By Augustine W. Wright, Consulting Engineer; Member American Society Civil Engineers; Member Western Society Engineers, etc. Chicago: Rand, McNally & Co., Publishers.

The author possesses exactly the sort of ability to write a book of this kind, through years of practical experience in constructing street railways, in which work he is known as a careful and painstaking engineer. The whole subject of the construction of street railways is gone through with in a careful and fairly exhaustive manner, and the cost of the details of the work given. In the first chapter track construction is taken up and most thoroughly dealt with, then follows paving, track cleaning, equipment, buildings for street railways, and management of street railways, equally well handled.

In the appendix the question of the actual power used in propelling street cars is taken up.

The work is quite fully illustrated, and we have no doubt will be welcomed by those interested in the construction and management of street railroads.

## QUESTIONS AND ANSWERS.

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.*

(244) E. L. H., Westcliff, Col., asks: Are there any locomotives in America that run with a steam pressure of 200 pounds per square inch? *A.*—The highest pressure that we have heard of is 190 pounds per square inch. There may be a few locomotives running with 200 pounds per square inch, as in the majority of modern engines the boilers are made strong enough to carry this pressure. 2. What is the danger arising from foaming in the boiler? *A.*—When the boiler is foaming it is difficult to determine the amount of water in the boiler; should the water become too low, injury to the boiler or an explosion may be the result.

(245) E. H., Mountain View, N. J., writes: I have a pair of 8"x16" engines, making 120 revolutions; boiler pressure 65 pounds. These engines are working a screw press and geared as per sketch. Please tell me how much pressure I get under the follower, and the rule for determining the same. *A.*—First determine the distance through which the follower or end of screw will travel during the time the engine makes 120 revolutions. According to the number of teeth in each wheel given in your sketch, we find the screw will make 6 turns during the time in which engine makes 126 revolutions. Since the pitch of the screw is 1 thread in every $2\frac{1}{6}$ inches, it follows that the end of the screw of the follower will travel through a distance of $1\frac{1}{4}$ feet for every six turns of the screw. Hence for every 120 turns of the engine, the end of the screw travels through $1\frac{1}{4}$ feet. Our next step will be to find the power and effect of the engine. The power of the engine is the energy which the engine can exert to overcome resistances in a given time, and is estimated by the product of the sum of the areas of the two pistons into the pressure per square inch, and the speed of pistons per minute. The effect of the engine is the useful work performed in some interval of time of definite length, and in our example is equal to the power minus the friction. The area of one piston 8 inches in diameter is 50.26 square inches; hence the sum of the areas of the two pistons is equal to 100.52 square inches. Assuming that the mean effective pressure is 40 pounds per square inch, then the total pressure on the two pistons is equal to

$$100.52 \times 40 = 4020.80 \text{ pounds.}$$

During one revolution of the engine the piston will travel through $16 \times 2 = 32$ inches $= 2\frac{2}{3}$ feet, and in 120 revolutions the pistons will travel through

$$2\frac{2}{3} \times 120 = 320 \text{ feet}$$

Consequently the engine is capable of exerting an energy of lifting 4020.8 pounds 320 feet high per minute. We believe it is safe to say that the power required for overcoming the friction of the gears and screw will amount to 75 per cent. of the total energy exerted by engine, consequently the power left to useful work will be equal to raising a weight of 1005.2 pounds through a distance of 320 feet per minute, or equal to

$$1005.2 \times 320 = 321,664 \text{ pounds}$$

raised one foot high per minute. But we have already seen that during the time that the pistons travel through 320 feet the screw travels through $1\frac{1}{4}$ foot, consequently the pressure of the screw will be equal to

$$\frac{321,664}{1\frac{1}{4}} = 257,331.2 \text{ pounds}$$

or 128.6 tons at 2,000 pounds per ton.

(246) H. P. D., Milford, N. H., asks: 1. What are the acids used and how is the process conducted by which articles of bronze are made bright before lacquering? *A.*—New work will merely require to be freed from dust, and rubbed with a piece of wash leather, to make it as bright as possible. Put the work on a hot iron plate (or upon the top of a stove), till it is moderately heated, but not too hot, or it will blister the lacquer; then according to the color desired, take of the preparations and, making it warm lay hold of the work with a pair of pincers or pliers, and with a soft brush apply the lacquer, being careful not to rub it on, but stroke the brush gently one way, and place the work on the hot plate again till the varnish is hard; but do not let it remain too long. Experience will best tell you when it should be removed. Some, indeed, do not place it on the stove or plate a second time. If it should not be quite covered, you may repeat it carefully; and if pains be taken with the lacquer it will look equal to metal gilt. In order to prepare old work for lacquering, make a strong lye of wood-ashes, which may be strengthened by soap lees; put in the old work and the

lacquer will soon come off; then have ready a mixture of aquafortis and water, sufficiently strong to take off the dirt; wash it afterwards in clean water, and lacquer it as before. The sample you have inclosed, and to which you refer, was ground or filed smooth. 2. What is the life of a boiler? Or how many years is it safe to use a boiler, allowing that it has had careful usage? *A.*—The life of a boiler depends greatly on the quality of water used. Some engineers claim that, on general principles, they should be condemned at the end of ten years' service.

(247) F. B., Cincinnati, O., writes: I am a machinist and have a job at tempering spring steel 3-64 to 1-16 inch thick, ¾ inch wide and 14 to 20 inches long, and have no success: they are generally too hard or too soft. They have to bend into a circle and spring back straight. Please give me a process for tempering this sort of spring through your paper. *A.*—To do such a job of tempering with uniform success, a man must be a blacksmith, skilled in the art of tempering, and it is due to the fact that you are not a skilled temperer, but a machinist, that you have no better success. Of course you can by practice learn to do it. We might give you some directions about careful heating, drawing, etc., but you probably know all that already, or if you don't, our telling you would do little good. It is only by experience that such tempering can be done, and it requires a sort of knowledge which cannot be taught by books or papers. There is no particular secret about it, it is simply a matter of skill.

(248) P. L., Worcester, Mass., asks: 1. Why are hyperbolic logarithms calculated with 2.718281828 as a base? What is that number generated from, and what are the advantages of hyperbolic logarithms, over common logarithms with 10 as the base? *A.*—Hyperbolic logarithms are used for computing the areas included within hyperbolic curves, and are most convenient for that purpose. We cannot fully explain the matter, however, without a diagram, which you will find in Weisbach's Mechanics of Engineering. The base is generated by the addition of the following series $1+1+\frac{1}{2}+\frac{1}{1\cdot6}+\frac{1}{1\cdot2\cdot4}+\ldots=2.718281828$, as you will find fully explained in the same work. 2. The lead screw on a lathe is five threads to the inch. I wish to cut a screw having one thread in five millimeters. What is the best way to gear in order to do it? *A.*—Really there is no way of doing it exactly without a metric lead screw. A close approximation is obtained, however, on a lathe which was illustrated in our columns Aug. 15, 1885, and since we do not know the construction of your lathe nor the gears which are available for you to use, we can perhaps best help you by giving the plan pursued for that lathe, which is now built by Dwight Slate, of Hartford, Conn. This lathe has a lead screw of 10 threads per inch, and is compound geared. When metric threads are to be cut the 59 gear on the spindle and the 118 gear on the stud are replaced by the translating gears 50 and 127. Now this lathe may be called double compound geared, *i. e.*, there is first a stud, which, when cutting ordinary screws, runs at one-half the speed of the spindle, then in the train there is another stud which again divides the speed by two, so that if the driver on this last stud was 50, and the gear on the screw was 50, the lathe would cut 40 threads per inch. Now, by putting on the translating gears as given above, the relative speed of the first stud, and consequently of the whole train and the lead screw, is changed in that proportion, and all the other gears remaining the same the lathe will cut 20 threads per centimeter, which is equivalent to the screw you mention, one thread in five millimeters. Of course, in gearing your lathe, however, you would have to allow for the fact that the pitch of your lead screw is twice as great. This gives a very close approximation. Another method for an approximation, which is close enough for most purposes, is given by Frank H. Richards, in our issue of Oct. 15, 1881.

(249) W. S. L., Battle Creek, Mich., writes: 1. The Patent Office, in their drawings, assume the light to come from the upper left-hand corner at 45 degrees angle. I understand how to apply this simple rule in orthographic projection, but am a little mixed in applying it to perspective. One of the department draftsmen states that it is the middle, or projecting line, which should be heavy, but it seems to me that there are other lines besides the middle line that should be shaded. *A.*—In orthographic projections the shade lines simply indicate the limit of the illuminated part from the shade part of the body; or in other words, the shade lines separate the illuminated part from the shade part of a body. (See "Practical Drawing," AMERICAN MACHINIST, June 18, 1887.) Since in orthographic projection the body from which the light emanates is always supposed to be in one and the same relative position to that of the body, it follows that the positions of shade lines in the projection of a body are clearly defined, and the rules resulting therefrom must be adhered to. The object of orthographic projection is to represent with accuracy all geometrical magnitudes on planes, the eye, or point of sight being at an *infinite distance* from the plane of projection. The object of perspective, on the other hand, is to represent objects on a surface in such a manner that the representations shall present to the eye, *situated at a particular point*, the same appearance as is presented by the objects themselves. The art of perspective is divided into two parts, namely, first: To find the points in which the visual rays pierce the perspective plane, which determines the general outline of perspective, and is called *Linear Perspective*. This branch is, like orthographical projection, strictly mathematical. The second part of perspective is called *Aerial Perspective*, and has for its object the shading and coloring of the outline, so that it shall appear in every respect like the object itself; and can only be learned by a careful study of the object from nature, under the guidance of an improved and cultivated taste. Therefore, in perspective drawing, the lines which represent parts of the object nearest to the point of sight are generally drawn heavier than the other lines, so as to create a receding appearance in the outline of objects, making the finer lines correspond with the appearance of those parts of the object which are not so distinctly seen on account of their greater distances from the eye. 2. Is there any case in perspective, in which, for instance, the top of sills would be shown wider than in the plan, the latter being placed in the ordinary way, that is to say, the picture plane is placed between the eye and the plan? *A.*—No.


## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.*

Gear Wheels See adv., page 16.
Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link Belt Machinery Co., Chicago and N. Y.

Taper attachment on all lathes Lodge, Davis & Co.
Compound rest on all lathes Lodge, Davis & Co.
Power cross-feed on all lathes Lodge, Davis & Co.
Large hollow spindle on all lathes Lodge, Davis & Co
Automatic stop on all lathes Lodge, Davis & Co.
See special ads. pages 15 and 16 Lodge, Davis & Co.

Shafting Straighteners. J. H Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 56 Beekman street, New York.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Improved fine tools for mechanics, mant'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

"Swift" Sight-feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortland st., N.Y.

Silk wiping towels are better and cheaper than waste. S. A. Smith, 23 South Canal st., Chicago, Ill.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Artesian salt and oil well pumps; sucker rods and deep well supplies; wrought-iron tubing and steam pipe. Hardwicke & Ware, Buffalo, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Accurate Cam Cutting—Specialties in fine light machinery, patented articles in line of machine work. Wardwell S. M. Co., Woonsocket, R. I.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator See May 5, p. 14. Send for circular No. 17. Curtis Reg. Co., Boston Mass.

Robertson's damper regulator; no diaphragms, springs or packing: the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

The Holley Manufacturing Company, of Lockport, N. Y. will send on application, their pamphlet illustrating pumping machinery and reports of duty trials.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot water apparatus for domestic and general purposes. By F. Dye. 82 pages with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 12 Cortlandt street, N. Y.

James D. Cardell & Co., 1900 Passyunk ave., Philadelphia, Pa., boiler makers, manufacturers of tanks, stacks, and all kinds plate iron work; coils of wrought-iron pipe for ice machines, blast furnaces, paper mills, dye houses, etc., also coil boilers.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 7, 1888 issue 47 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 61 articles have thus far appeared up to and including the March 31, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.


## MANUFACTURES.

J. Q. Munson will build a planing mill at Pineville, Ky.

Smelting works are to be erected at Pueblo, Col., by Holden & Guggenheimer.

The Concord (N. H.) Axle Company say they are three months behind their orders.

The contract for erecting the buildings for the car works at Decatur, Ala., has been let.

William H. Hoffman & Sons, Hoffmanville, Md., will rebuild their paper mill recently destroyed by fire.

The Gas Engine and Power Company, 131st street, New York, are building large shops at Morris Dock, New York city.

The Gas and Electric Works, Fort Worth, Texas, will largely increase their capital stock and extend their operations.

The Perkins Manufacturing Company will rebuild their planing, lath and shingle mills, recently burned, at Harrison, Ga.

The Bailey-Lebby Manufacturing Company has been incorporated, to manufacture and sell machinery, at Charleston, S. C.

The Eclipse Manufacturing Company will remove their offices May 1 to 418 Rookery Building, corner Adams and La Salle streets, Chicago, Ill.

The contract is let to build the roundhouse and repair shops for the Sheffield & Birmingham Coal, Iron and Railroad Company, at Sheffield, Ala.

A company has been chartered to build sewing machine motors at Atlanta, Ga. It is known as the Clayton Sewing Machine Motor Company.

The Arnold Print Works, North Adams, Mass., will erect two large buildings, 45 x 100 feet and 65 x 100 feet. One of these buildings will be used as a blacksmith shop.

The Watts-Campbell Company, Newark, N. J., have added to their steam engine catalogue a cut and description of the compound engines built by them for the Shrewsbury Mills.

The Boston Heating Company have adopted the Curtis pressure regulator, and are using them in sizes from ⅛ inch to 3 inches, to reduce the 400 pounds pressure on their mains, to from 5 to 80 pounds for heating and power.

The Glines & Holmes Manufacturing Company, which has just been incorporated, has leased part of the building at the corner of South avenue and Water street, Bridgeport, Conn., and will manufacture light hardware specialties.

Jas. A. Crouthers, 112 Liberty street, New York, sends us the latest catalogue of the Baragwanath steam jacket feed water boiler and purifier. In addition to illustrations and descriptions, the catalogue contains tables and information useful to engineers.

An order by the Cambria Iron Company, at Johnstown, Pa., suspends all Sunday employment in the steel works and blooming mills, and as far as possible at the blast furnaces. Under the new regulation the works will be idle from Saturday night to Monday morning.

The Cincinnati Corrugating Company, Cincinnati, Ohio, send us a catalogue of their corrugated sheet-metal building material. It is well illustrated, and sets forth the merits of what is undoubtedly an excellent building material. Very clear directions for ordering and using the material are given.

The Ross Valve Company, Troy, N. Y., have brought out a new reducing valve especially designed for use in heating cars by steam. The company are meeting with good success in introducing their water engine for blowing church organs. They have good testimonials as to the operation of these engines.

The plant of the Connecticut Rubber Manufacturing Company is to be removed from Naugatuck to Norwich, Conn. The decision was formally reached at a stockholders meeting on Wednesday, and it was voted to put up a new factory at Norwich, and continue work at the Naugatuck shop until the other is ready.

New water works, or the enlargement of old works, are contemplated at Chetopah, Kan.; Washington, Mo.; Bellwood, Pa.; Bushnell, Ill.; Greenville, Miss.; Wayland, Mass.; Ligonier, Ind.; Glen Elder, Kan.; Parkhill, Ont.; Memphis, Tenn.; Girard, Kan.; Kingston, Ont.; St. Augustine, Fla.; Pittsburgh, Pa.; Allegheny, Pa.

Mackintosh, Hemphill & Co., Limited, will make extensive improvements in the Fort Pitt (Pa.) Foundry. A brick building 230 x 115 feet, and an iron structure 220 x 90 feet are being erected. Eight new traveling cranes, two that will have a capacity of 25 tons each and the others 15 tons each, will be put up. The working force will be increased by about 200 men.

Lodge, Davis & Co., Cincinnati Ohio, have bought additional ground and will build new shops at once. The new works will cover the entire block bounded by Eggleston avenue, Sixth, Culvert and Corkran streets. They write us that they are now running to full capacity, with large advance orders. When the new shops are completed they contemplate bringing out several new lines of machine tools.

Curtis & Curtis, Bridgeport, Conn., write us: "We have this day received an inquiry in regard to our pipe machines and die-stocks from Wauganui, New Zealand, in which the party states that he saw our advertisement in the AMERICAN MACHINIST. Our new factory is getting along rapidly, and we trust to be able to move in by the first of July. Our pipe machines have become of such general use by the trade that the additional room and facilities will be very acceptable."

Sterling Elliott, Newton, Mass., has issued a catalogue, which is undoubtedly the most unique of its kind yet published. A little space is given to illustration and description of various machine tools, the remainder of the work being devoted to humorous illustrations in the shape of broad caricatures, sure to make any machinist in the world laugh if he hasn't forgotten how to do so. The catalogue—if that is the proper name for it—is well printed on a superior quality of paper, and artistically gotten up in every respect.

The Triumph Heat and Light Company was organized under the laws of the State of Maine at Portland, recently, with the following officers: President, Edmund Rodman; vice-president, John McInnis; directors, Edmund Rodman, John McInnis, Joshua B. Winslow, James H. Murkland, Robert B. Carsley, John W. Cornell, and Frank C. Smith, of Cottage City; secretary and treasurer, James L. Gillingham. The company will manufacture in New Bedford under patents of Robert B. Carsley, burners for burning gas and gasoline and kindred vapors, also stoves and reservoirs for the production and storage of gasoline vapors for heating and lighting purposes. The capital stock is to be $500,000, with 50,000 shares.

Hardwicke & Ware, of Buffalo, N. Y., manufacturers of artesian and deep well supplies and a miscellaneous assortment of brass goods, have their foundry and blacksmith shop on the third floor of their factory building, the principal object being to get rid of dust and smoke, as their works are located in the heart of the city. Their drawing room is in charge of a lady, the wife of their superintendent, Mr. Ross. She learned drawing of her father who was an expert draftsman. She has also a good knowledge of pattern and moulding work and all without prejudice to her fitness to adorn the drawing room of her home, as well as that of Messrs. Hardwicke & Ware. This firm have been doing a good deal of work for the Martin Car Heating Company, of Dunkirk, N. Y. The new factory which the latter company is building is now, however, about ready to equip with machinery.

The *Cumberland* (Md.) *Daily News*, speaking of the Beall Foundry and Machine Works, at Cumberland, Merwin McKaig proprietor, says: About three years ago Mr. McKaig turned his attention to the manufacture of iron shafting for the various kinds of machinery, and in this he was signally successful. All the machinery used in making the shafting is the invention of W. J. Muncaster of Mr. McKaig's establishment, and is covered by patents. It was all manufactured in the McKaig shops, and is one of the most complete and extensive plants of any kind in use in our city. It has been constantly added to and improved, and even now Mr. Muncaster is at work perfecting certain details. The machinery as it stands is far in advance of anything in this line in the country, and Mr. McKaig receives inquiries regarding its manufacture and sale, not only from many prominent firms in this country, but from manufacturers in Sheffield, London, Paris, Germany and Bombay, India. Two of the machines have been patented in England. * * * The rapidly increasing trade in the shafting and other products has considerably cramped Mr. McKaig's factory room, extensive as it is, and we understand that it is in contemplation to greatly extend the business in the near future and to erect a large works, especially for the manufacture of shafting in large quantities.

## Machinists' Supplies and Iron.

New York, April 26, 1888.

Iron—American Pig—We quote No. 1 X Foundry at $20.50 to $21, other brands at $19.25 to $19.50. No. 2 X Foundry, $18.50 to $19.50, and Grey Forge $16 to $17.

## ✲WANTED✲

*"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.*

Wanted—Men to sell planes, see page eleven.

An experienced mech. draftsman wants position. Address Kpt., Am. Machinist.

Wanted—A situation by an experienced draftsman. Address Mechanic, Am. Machinist.

Mech. draftsman experienced on Corliss engine & gen. mach. work wishes position. S. A., Am. Mach.

Wanted—Good machinist, well recommended; state wages. Standard Mach. Co., Weedsport, N.Y.

Situation wanted in New York or Brooklyn by a first-class draftsman on marine engine or general work. H. P. A., Am. Machinist.

A mechanical draftsman, first-class man, able to take charge of drawing office, would like to change position. H. S., Am. Machinist.

Wanted—First-class draftsman familiar with pipe foundry details. Address with references and full particulars, M. F., Am. Machinist.

A good mech. draftsman wants to change position, if something permanent and prosperous is offered. Correspond with "A," Am. Machinist.

Foreman boiler maker wants situation; can lay out marine, locomotive and stationary work; best of references given. Address S. M., Am. Machinist.

Superintendent or foreman, good mechanic, practical, desires to make a change; steady and reliable. W. Plume, 271 Tompkins ave., Brooklyn.

A competent assistant draftsman wants a Western position with a machine company, where mathematics are used and improved methods employed. Address R 30, Am. Machinist.

Wanted—A machinist and iron founder, practical sober, economical: able to handle 100 or more men, as foreman and possibly as superintendent; must be able to figure cost of production correctly. Address E. M., Am. Machinist.

Wanted—Position as machine shop superintendent by first-class designer and draftsman, with extensive and varied experience in steam engine, locomotive, marine and mining work, etc. Address Wm. Y. Silver, Box S, Trinidad, Col.

A young man, graduate of technical school, with 11 years' practice as draftsman and machinist, able to design and build jigs and fixtures for manufacture of specialties, would like a position to assist foreman in manufacturing machine shop. A. G., Am. Machinist.

Machinist Wanted—An intelligent young machinist with $2,000 is wanted to purchase one-half interest in a light machine manufacturing business which is well established in Boston. He must take charge of machine work, and in addition to his share of profits will receive fair wages. Address L. G., care Am. Machinist.

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August C. Christensen, 26 Church st., N. Y., mech. and hydr. engineer. Prepares designs of waterworks pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

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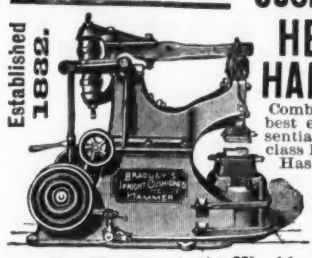

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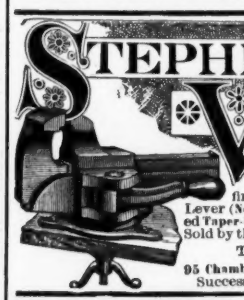

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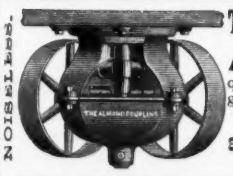

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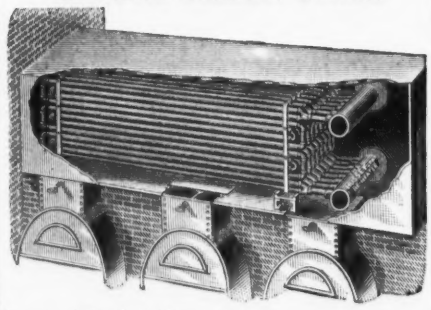

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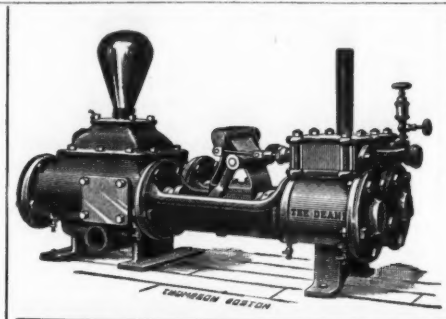

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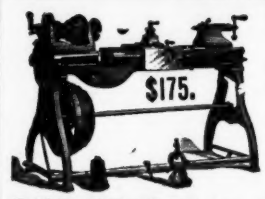


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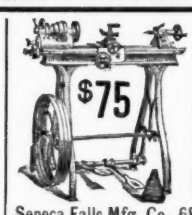


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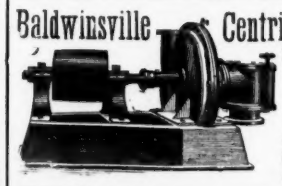

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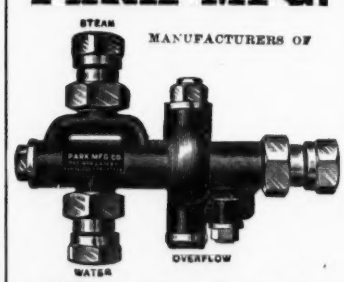


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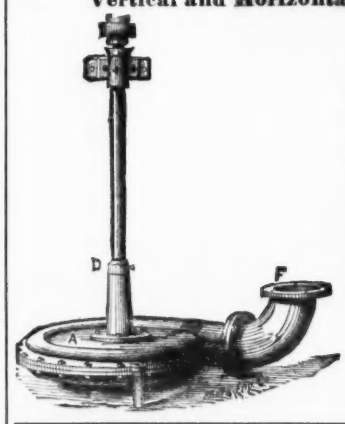


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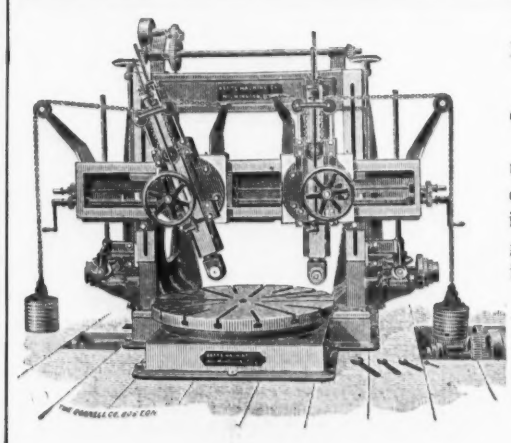

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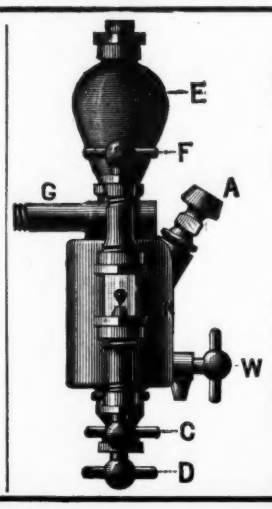


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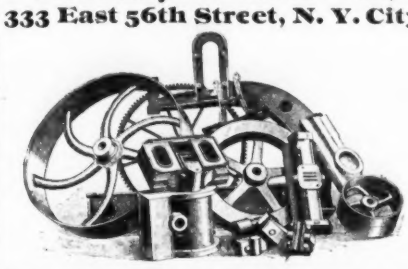

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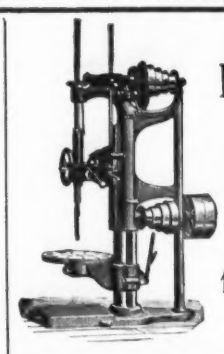

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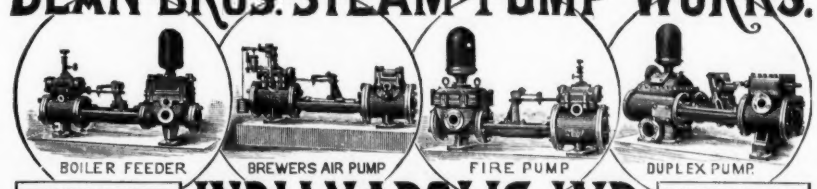


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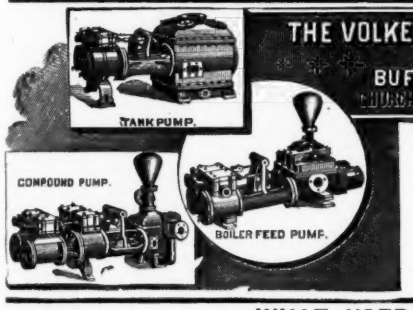


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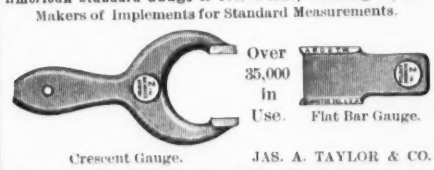

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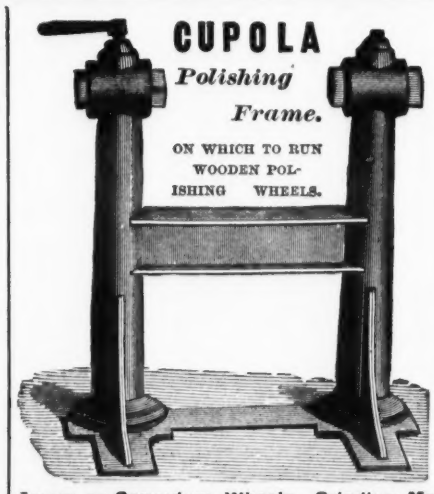

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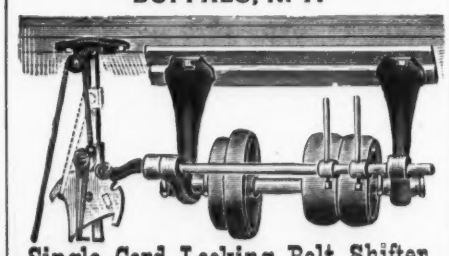

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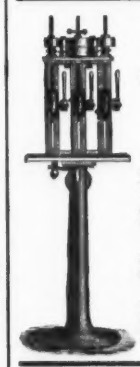

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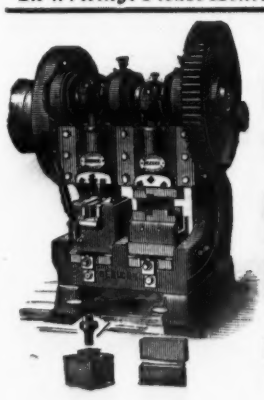

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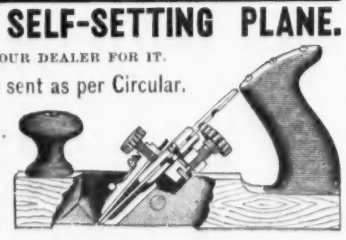

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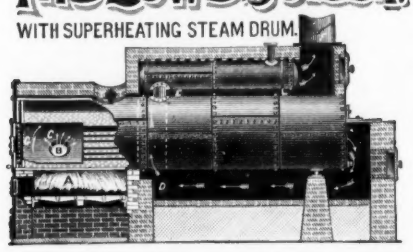

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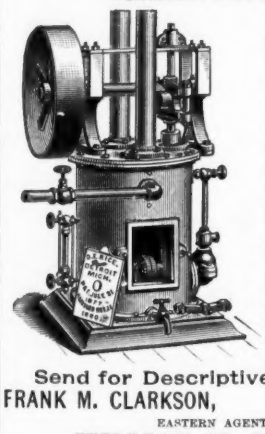

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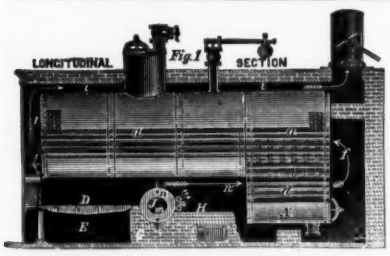


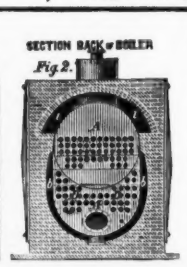


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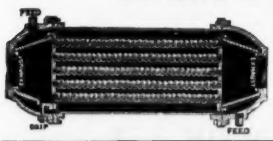

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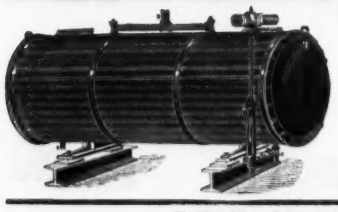

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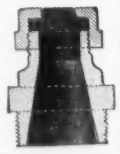

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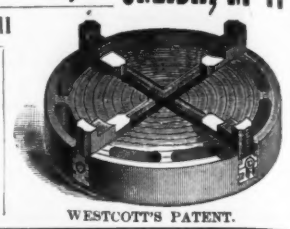
| 21 1-4 in. | 26 in. |
| 24 in. | 30 in. |
| 30 in. | 36 in. |
| '36 in. | 43 in. |



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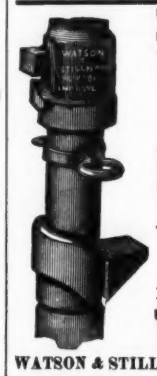

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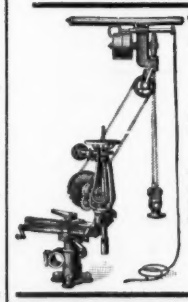

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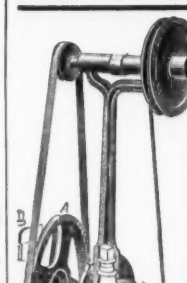

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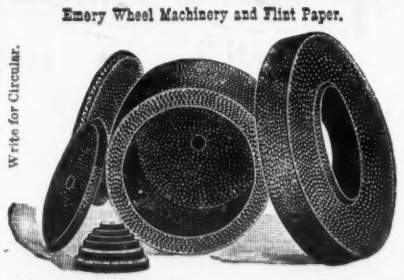

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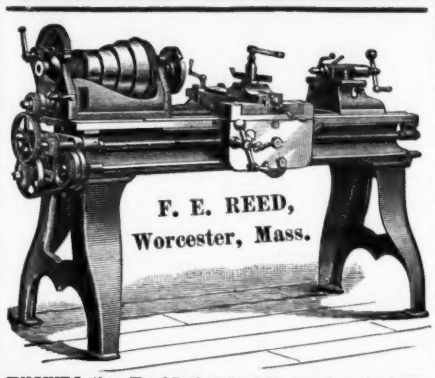

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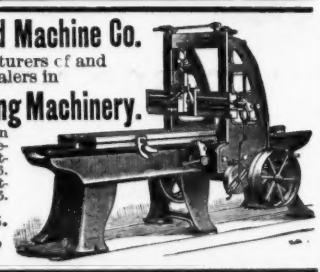

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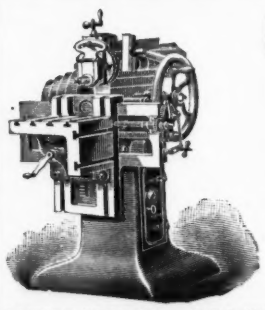

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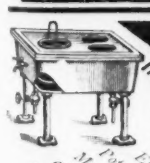

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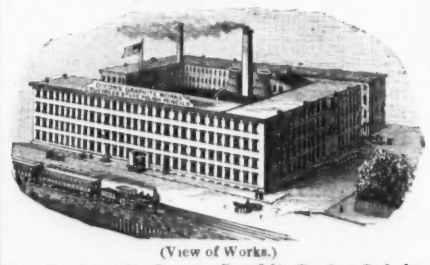

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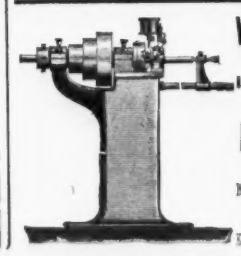

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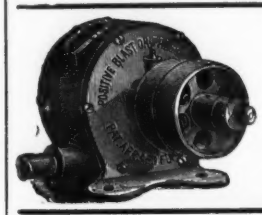

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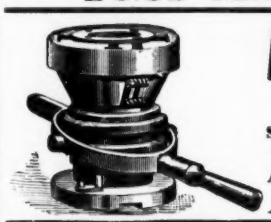

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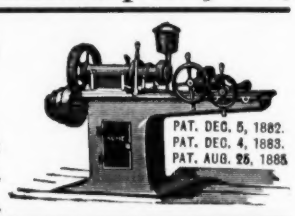


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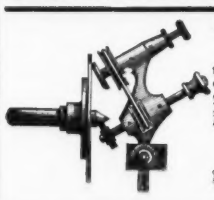

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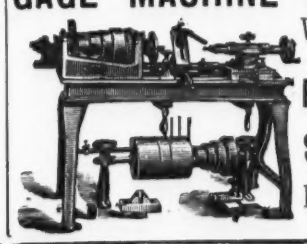

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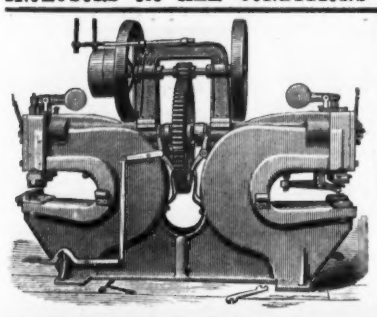

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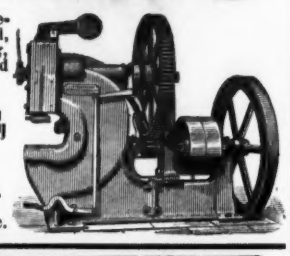

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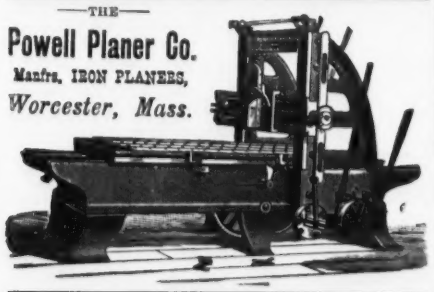

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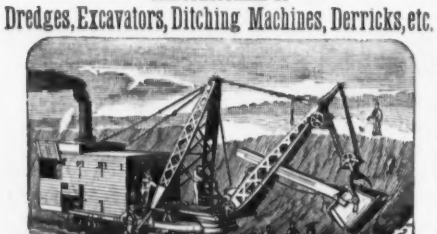

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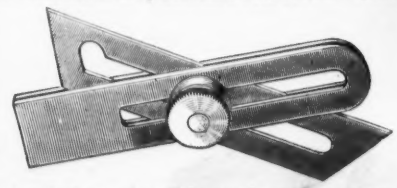

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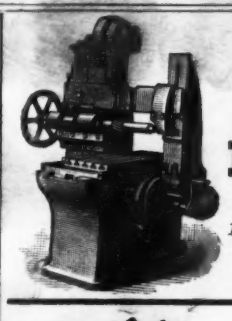

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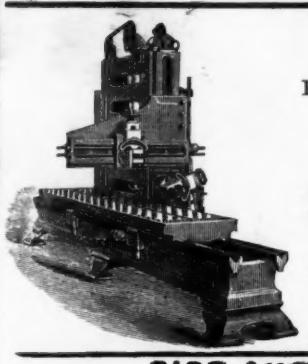

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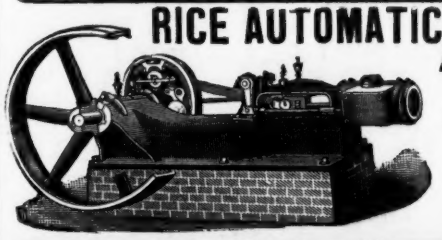

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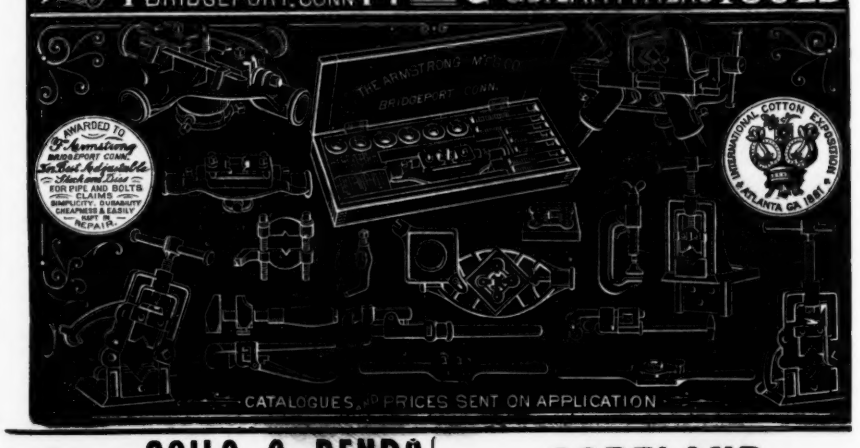
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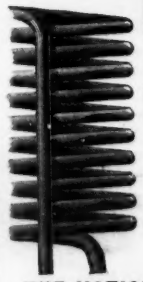

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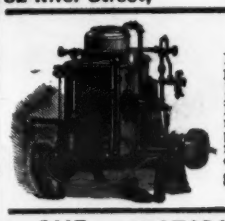

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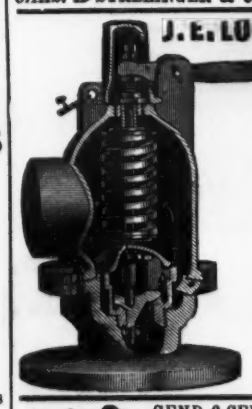

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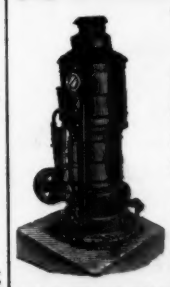

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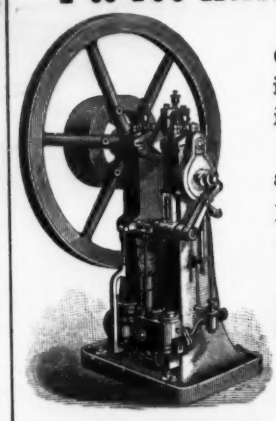

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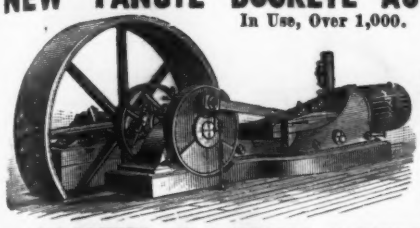

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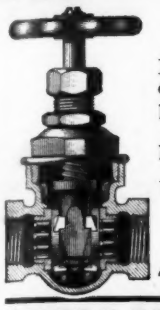

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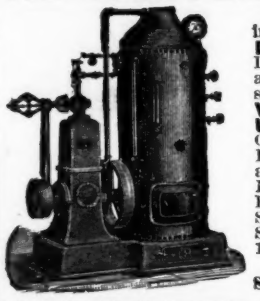

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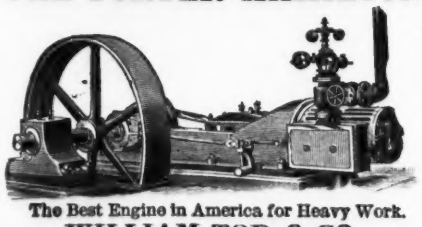

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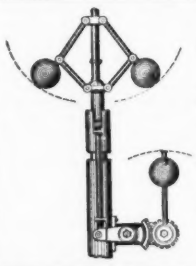

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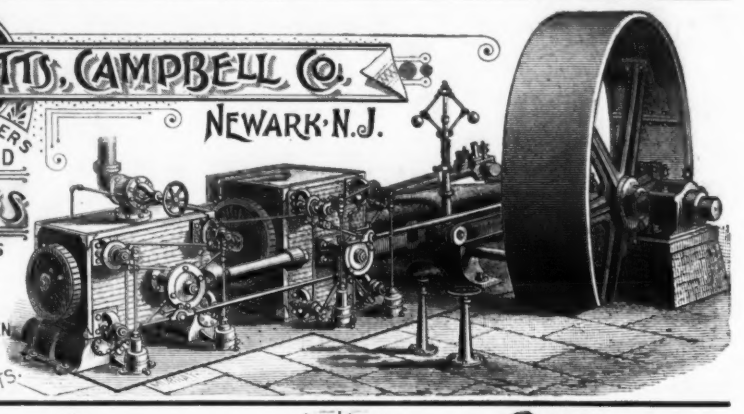

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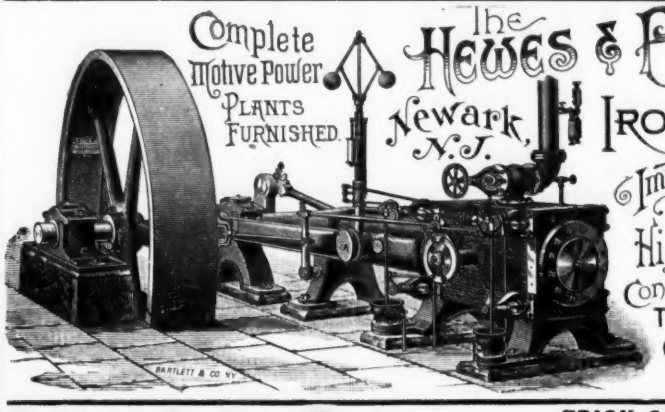

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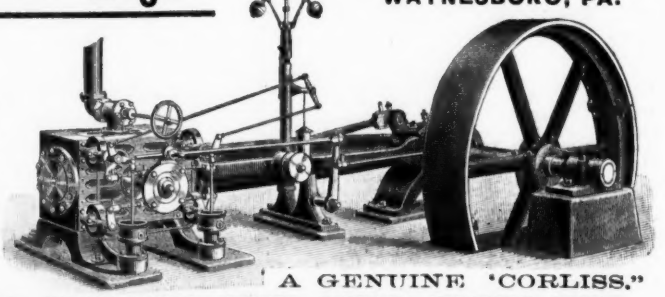

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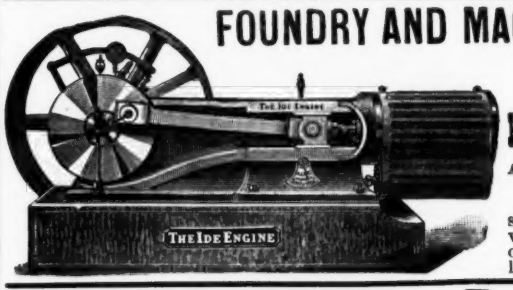


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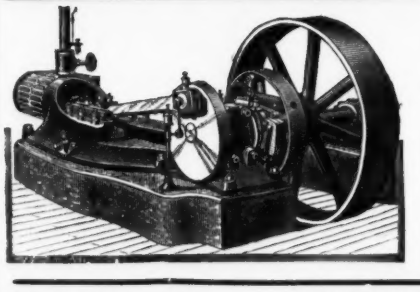

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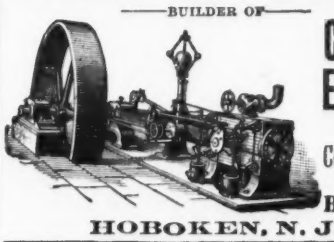

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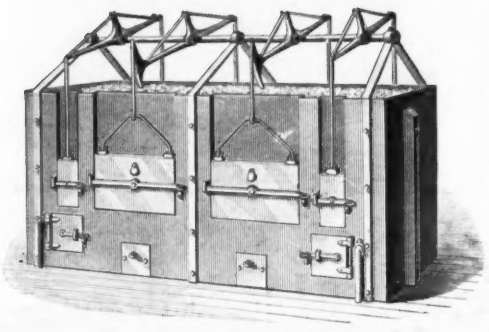

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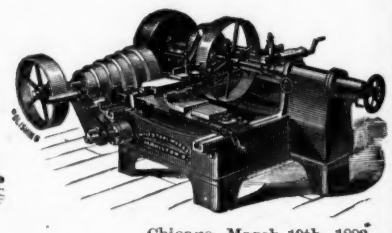

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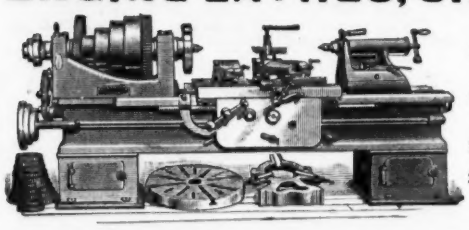

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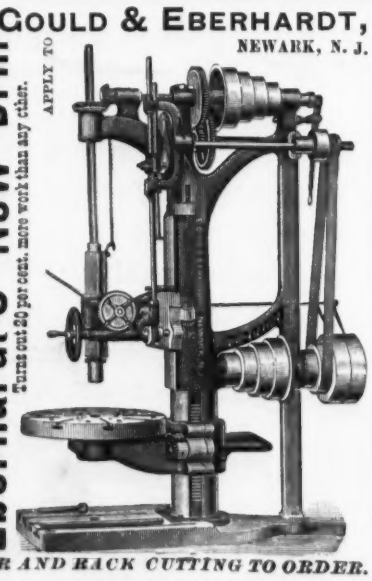

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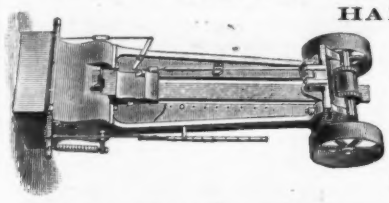

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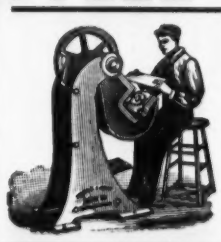

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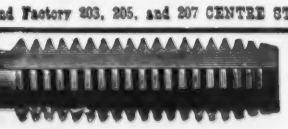

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